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April 2015
Issue 414

YOUR EXPERT

GUIDE TO TODAY'S TECH



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ON TEST**

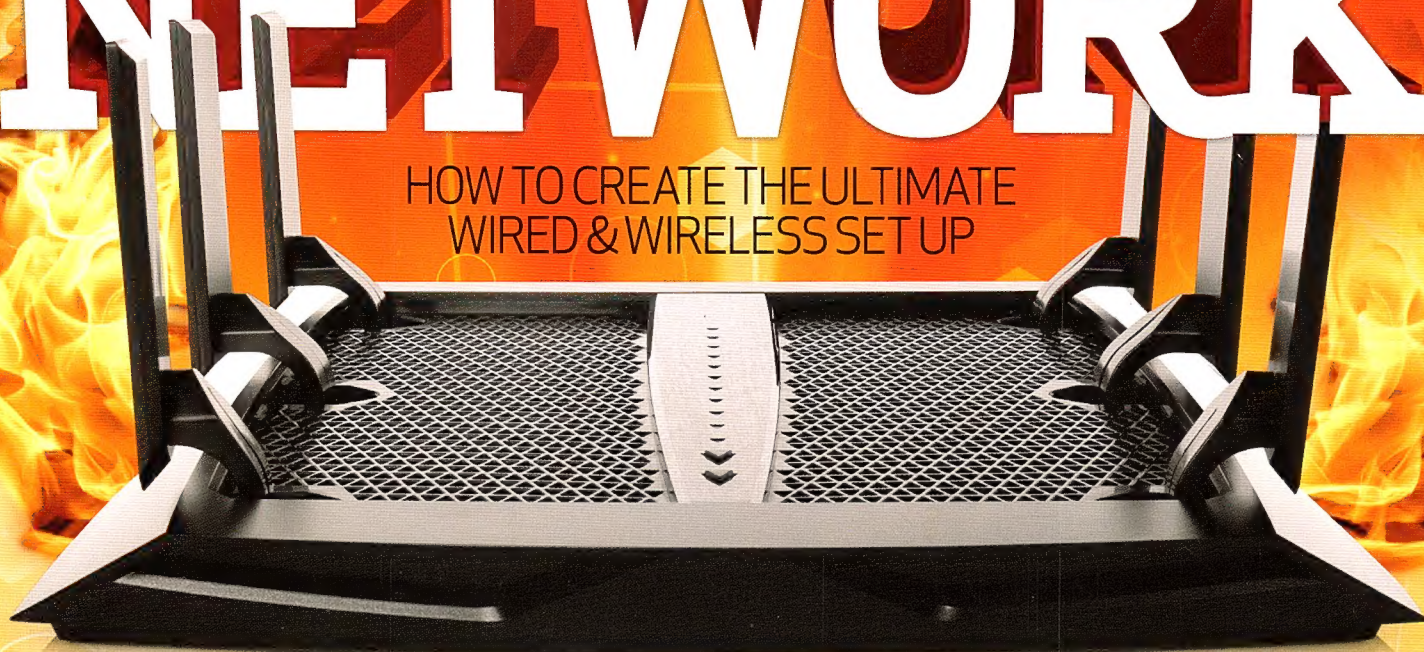
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+ troubleshooting
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HOW TO CREATE THE ULTIMATE
WIRED & WIRELESS SET UP



**COMPREHENSIVE
TUTORIALS**

- Overclock your graphics card in Windows
- Construct the ultimate power-house PC
- Coding GUIs
- Create a Pi music server

**HOT NEW
PCs & TECH**

- The return of the Sound Blaster!
- Samsung's blazing-fast portable SSD
- Android TV tuner + iOS USB storage key

**MACBOOK
AIR KILLER**

Can Dell's new 13-inch Windows ultrabook really take on Apple's MacBook Air?



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Microsoft's new strategy, just like its old strategy

APC's editor considers whether Microsoft's
change in tack can help the tech giant come
good in the age of the smartphone.

Microsoft arguably
achieved dominance in
the first era of personal
computing (that was
ruled by desktop and laptop PCs) by
building software – office apps
– that became the key reasons to
pick up a PC in the first place.

Under Steve Ballmer, Microsoft's
first attempts to deal with the rise of
the smartphone era was primarily
to ape Apple – building devices that
it hoped people would love, like its
Surface tablets, and a radical
redesign of Windows. It's pretty
clear that this approach failed –
Windows 8 was widely rejected and
Microsoft was left holding over
US\$900M worth of unsold Surface
inventory. Steve Ballmer was given
the boot and Satya Nadella, who'd
led the company's moves into the
cloud, was put in charge.

Nadella's made some quite
contentious, headline grabbing
moves, but they're ones that – at
this point – are essential if
Microsoft hopes to survive in this
new age of computing. A lot has
changed, even in the past 5 years.
We're no longer living in an
computing market dominated by
selling hardware and the software
to run on top of it. Today's biggest
names are nebulous services that
consumers and businesses don't
'own' – the likes of Facebook,
Instagram and Twitter have ushered
in a host of changes to the way many
businesses position and sell their
products, with many shifting to
'software as a service' models,
typified by Adobe's Creative Cloud.

With Microsoft choosing to make
Windows 10 a free upgrade for

owners of Windows 7 and 8 is a good
all-round indicator of Nadella's
strategy. The company'll take a hit
to its bottom line in the name of
good PR and convincing users to
continue on the Microsoft ride. And
that's perhaps the company's biggest
struggle: getting people to use its
products in the face of so much good,
free competition (from the likes of
Google and other new cloud-centric
companies). A small but positive sign
for Microsoft is its recent Outlook
app for iOS and Android. Though it
is, in part, just a slight rework of an
app that Microsoft bought earlier in
2014, its approach is surprisingly
open: it doesn't just work with
Outlook.com email, but can be used
with Gmail, Yahoo! and Apple email
accounts as well as letting you
attach and save files to third-party
cloud storage services like Dropbox,
Google Drive and Apple iCloud Drive.
And it's a pretty great mobile email
app, when all's said.

It's a strategy that flies in the face
of most other big tech vendor's
tactics: to try and lock users into
their own platforms and services.
But then, Microsoft's original
dominance didn't come from locking
down its platforms – a large degree
of openness was key. So can that
strategy, tweaked for the cloud age,
work again? ■



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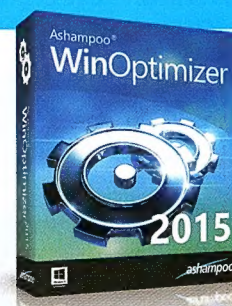
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Find your disc inside on page 83.

technotes

» NEED TO KNOW

Three strikes to tackle illegal downloads

Telecommunications industry looking for a home to end piracy.

A 'three strike' scheme has been drafted by Australia's internet service providers and the telecommunications industry body Communications Alliance that would see online copyright infringers warned three times within a 12-month period before copyright owners can lodge a Federal Court request to have ISPs reveal identities and contact details.

The warnings would be of an escalating nature, with 'education', 'warning' and 'final' notices sent by ISPs to customers whose IP addresses have been used for copyright infringement.

If a 'final' warning notice is not sent to a user within that 12-month period, the scheme will then reset, sending the number of warnings for the individual back to zero.

The three strikes proposal was drafted at the request of Minister for Communications Malcolm Turnbull and Attorney General George Brandis. The government has placed a deadline of April 8 for copyright owners and ISPs to come to some form of agreement on the matter, or else it will come up with a scheme of its own.

Stephen Lambrechts

Valve and HTC show off VR lovechild

Vive headset the result of an unexpected pairing.

HTC has demonstrated an early demo of an upcoming VR headset at this year's World Mobile Congress in Barcelona, saying the final product should be available to consumers by year's end. Made in partnership with PC gaming giant Valve, the two companies are hoping that HTC's hardware know-how and Valve's software prowess will help create a headset that makes techies weak at the knees. Early hands-on tests sound like they might pull it off. HTC has made picture clarity a focus, delivering two 1,200 x 1,080 screens running at a 90Hz refresh rate. The other area the Vive stands out is that it allows movement within a 3 x 4m room, well over double the area offered by the Oculus Rift DK2 (aka Crescent Bay). There are downsides to HTC's approach, however. In order to keep latency low, for example, the headset will have to be connected by an HDMI cable. There's also the problem of price with the Vive expected to cost considerably more than other headsets. That said, with content partnerships that include Vertigo Games, Bossa Studios, Dovetail Games, Wemo Labs, Google, Steel Wool Games, and Owlchemy Labs, it may offer enough compelling experiences to make it worth it. Joel Burgess



Throw out your hard drives!

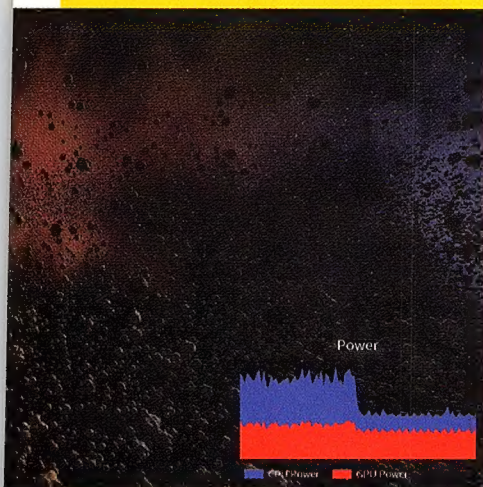
The NSA has a secret backdoor in almost every one of them.

According to an in-depth report from Kaspersky Labs, the National Security Agency (NSA) could be planting advanced malware in hard drive firmware, giving the agency unprecedented access to computers all over the world.

Cyber-espionage group Equation is reportedly responsible for the malware, which uses previously undiscovered techniques to plant malware on hard drives that's undetectable and impossible to get rid of — even formatting the drive won't do the trick.

The malware takes advantage of exploits found in hard drives from almost every major manufacturer to reprogram the drive's firmware, creating secret sectors that are only accessible through an application programming interface (API).

Equation uses a toolset that's remarkably similar to what the NSA has used in the past, based on leaked documents from 2013. While Kaspersky Labs can't outright say that the NSA is involved, the report certainly insinuates it. One also has to wonder how the NSA might've originally gotten access to the hard drive companies' firmware code... Stephen Lambrechts



DirectX 12 to allow cross-brand multi-GPU?

Unconfirmed early reports suggest pairing AMD and Nvidia cards may be possible in the next version of DirectX.

Launching alongside Windows 10, version 12 of Microsoft's bundle of gaming and multimedia APIs known as DirectX could be about to fundamentally change how gaming graphics cards deal with rendering.

At present, the traditional setup for using multiple GPUs means getting two of the same cards which then work together by rendering alternate frames (AFR). This current setup, however, means both GPUs have to have all the texture and geometry data stored in their buffers — even the unnecessary data for the 'alternate' frames. The result is that, even though you may have two cards with 4GB of memory, you'll still only have 4GB of frame buffer.

DirectX 12 has done away with this requirement, embracing a new Split Frame Rendering (SFR) technology which allows texture and geometry data to be split and allocated to specific GPUs. That effectively means that multiple GPUs can work simultaneously on the same frame with greater efficiency, and does away with the need for duplicate texture and geometry data.

The other key benefit is that SFR allows a dramatic reduction in latency — AFR requires about five frames to be pre-rendered in order to keep the display smooth, but SFR needs at most 1. The other kicker? It's speculated that DirectX 12 will be able to do all this across multiple architectures, allowing Nvidia GeForce GPUs to work together with AMD Radeon GPUs.

Joel Burgess



Malcolm Turnbull wants your metadata...

...yet still hides his own.

Malcolm Turnbull, Australia's Minister of Communications, has made it his mission to try and acquire your metadata — a move which would effectively take away much of your privacy on the internet — despite being a vocal opponent of data retention schemes before being appointed to his current position.

Clearly, he still thinks online privacy is quite important, as *The Australian* has reported that Turnbull is one of the many government ministers that uses the secret messaging app, Wickr.

Wickr describes itself as a "top secret messenger" that sends encrypted self-deleting messages, and which also deletes your metadata, including geolocation information and timestamps, making those messages impossible to trace. "Escape the Internet" and "Leave No Trace" are two of Wickr's taglines.

When asked about the app, Mr Turnbull said, "I use Wickr as an application, I use a number of others, I use WhatsApp, because they're superior over-the-top messaging platforms; hundreds of millions of people do."

Downloads of Wickr have surged since Mr. Turnbull's admission of use, moving from 546th to 76th position on Apple's App Store.

Stephen Lambrechts

EFF seeks DMCA exception for 'abandoned' games

A Harvard law student has teamed up with the Electronic Frontiers Foundation (eff.org) and submitted legal amendments to the US Copyright Office in an attempt to protect game preservationists from current laws in the Digital Millennium Copyright Act. Under the current legal framework, even if a developer has long-abandoned support for one of its older games, it's illegal for anyone to break the game's DRM — even if that's just to make the older title playable on current PCs. The unofficial programmers that keep these games alive — often as a labour of love — therefore expose themselves to significant and unnecessary legal vulnerabilities, something the EFF's new proposals seek to rectify. JB

Ikea to include wireless chargers in furniture

The Swedish furniture company Ikea has announced that it will release a new smart home range of products in April, centring around furniture with built-in wireless chargers. A partnership with Qi Wireless has spurred the creation of a range of lamps, bedside tables, stylised stand-alone chargers and wireless charging modules that can be incorporated into existing furniture. The smart furniture will also include USB ports for charging additional units. JB

Nvidia sued over GTX 970 memory claims

Back in January, Nvidia's mid-range GTX 970 graphics card was revealed to have a significant discrepancies between the design's reported 4GB memory spec and the way the actual hardware works. Investigators discovered that the 4GB total was effectively being partitioned into 3.5GB and 0.5GB segments. That finding has led to one Michigan, US resident to take out a class-action lawsuit against Nvidia. Although the differences don't significantly affect the GTX 970's performance, it's looking like the misrepresentation will take Nvidia some time — and now possibly millions of dollars — to smooth over with its customers. JB



720,000

THE NUMBER OF ANDROID WEAR DEVICES SHIPPED IN 2014.

Research firm Canlys recently published data about the 720,000 Android Wear devices that were shipped around the world last year. Though Samsung still held the lion's share of wearables in Q3 of 2014 (52%), Motorola's Moto 360 was the product leader in shipped Android Wear devices, comprising an estimated 15% of distributed wearables that quarter. The crowd-funded Pebble smartwatch, with over a million units sold since its launch in 2013, recently unveiled a new software update that's added Android Wear features to the third-party platform, placing it in the race for this year. The anticipated release of the Apple Watch in April is expected to spur further growth in the smartband and wearables markets in 2015.



one BILLION

THE NUMBER OF CUSTOMER-PROFILE DOCUMENTS STOLEN LAST YEAR.

According to the international web security company Gemalto, data breaches increased almost 50% last year over 2013 stats — and the specific theft of customer data records increased closer to 80%. Even more concerning is a reported shift in the motives behind large scale hacks, which is moving from online money theft to long-term identity theft schemes. Password managers (see APC December 2014, page 39) and two-factor authentication are the most effective measures to protect against identity theft.

US \$23,000

THE SALE PRICE OF A 25-YEAR-OLD COMPUTER ON EBAY.

A 3.54MHz CPU, 128KB of RAM (expandable to 8MB) and a display resolution starting at 320 x 200-pixels doesn't sound like the specs of a computer that recently sold for US\$23,000. But this cumbersome desktop computer, which is less powerful than one of today's entry-level fitness trackers, is something of an antique. The Commodore 65 — a.k.a the 64DX — was never officially released and only exists in prototype form, making it an exceedingly rare piece of early desktop-PC memorabilia. Considering they sell for around \$30,000, we assume they're also hard to hang onto.



IPHONE 6 PLUS OWNERS USE TWICE THE DATA OF THOSE WITH THE IPHONE 6.

While the amount of data downloaded by iPhone 4s and 5s owners is reasonably consistent according to market-research conducted by Citrix, it's been revealed that, in the US at least, Apple fans who've upgraded to the newer iPhone 6 models use noticeably more data than their forebears. Even more intriguing, however, is the large gap between the data downloads on iPhone 6 Plus and iPhone 6, with Citrix claiming that Plus users, on average, use twice the amount of data. The reason iPhone 6 Plus owners chew through more than the smaller 4.7-inch version? Those behind the stats have speculated that the Plus's phablet sizing means its being used more frequently, and for more tablet-like tasks like watching videos, than its smaller sibling.

40%

THE REDUCED LIKELIHOOD OF HAVING YOUR IPHONE PINCHED.

Thanks to a kill switch that Apple added to its devices in 2013, the number of iPhones stolen in San Francisco last year was 40% lower than previous years, according to a report by Reuters. In New York you were 25% less likely to have your handset nicked and on average, London had half the thefts of the previous year. Seeing as smartphone theft accounts for half of all crimes in San Francisco, the new kill switches have also affected the workload of local police. Samsung and Google offer similar features for Android devices and Microsoft is reportedly working one into the next version of Windows Phone.

REDDER, MEANER, BETTER THAN EVER



PALIT Get ready, gamers and enthusiasts! Encounter a new kind of thrill as Palit delivers unmatched performance and extreme capabilities with its new GeForce® GTX™ 960 JetStream series that includes the GeForce® GTX™ 960 Super JetStream and the GeForce® GTX™ 960 JetStream.

GEFORCE GTX 960
SUPER JETSTREAM

REDDER EXTERIOR

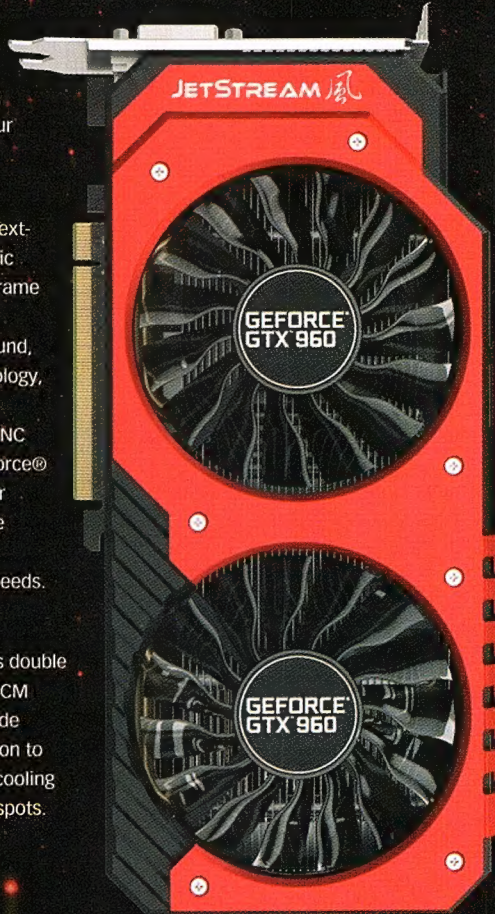
Flaunting the Palit GeForce® GTX™ 960 JetStream series cooler's bright red fan, which now sports a fan profile that is known as 0-dB Tech that stops the cooling fans for quiet operation, Palit's new cards will fire up your mood and stimulate you to be focused on your game!

MEANER CAPABILITY

The GeForce® GTX™ 960 JetStream features NVIDIA's next-generation Maxwell architecture, GPU Boost 2.0, Dynamic Super Resolution technology, MFAA technology (Multi-Frame Sample Anti-Aliasing) that lets you enjoy games in high quality without sacrificing performance, 3D Vision Surround, PhysX technology, GameWorks and GameStream technology, Adaptive Vertical Sync, PCI Express 3.0 support, support for four concurrent displays, and it is SLI-ready and G-SYNC ready to prevent screen tearing and stuttering. The GeForce® GTX™ 960 Super JetStream also features ThunderMaster OC utility, 4K Shadow Play, and GeForce Experience. The GeForce® GTX™ 960 JetStream, on the other hand, is essentially the same card, with lower operating clock speeds.

BETTER PERFORMANCE

Palit's JetStream series has a Dual Fan design that offers double the cooling performance, and combined with the 9CM-9CM Smart Fans that consist of dual fans with alternating blade rotations (each adjacent fan rotates in a different direction to reduce airflow conflicts and effectively improve overall cooling performance), the heat is effectively removed from hot spots. The Palit's JetStream series also features the TurboFan Blade that is designed to improve cooling performance by generating a powerful air stream and air pressure, and its thermal solution provides ambient lighting to further immerse gamers into the gaming world.



GEFORCE GTX 960 SUPER JETSTREAM

- CUDA Cores: 1024
- Core Clock: 1279MHz
- Boost Clock: 1342MHz
- Memory Config: 2GB, 128-bit

GEFORCE GTX 960 JETSTREAM

- CUDA Cores: 1024
- Core Clock: 1203MHz
- Boost Clock: 1266MHz
- Memory Config: 2GB, 128-bit

OVERCLOCKING PERFORMANCE

EXTREMELY QUIET

EXTREMELY COOL



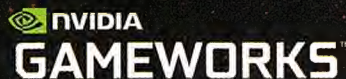
KEEP SILENT

Keep Silent while you are experiencing the multimedia application and general workload. The operating fans only occurs while working on heavier loading such as gaming that either GPU temperature surpasses 60°C or total board power over 60W.



DUAL ULTRA HD 4K

With its HDMI and DisplayPort ports, the Palit JetStream provides a flawless, jaw-dropping experience using dual 4K monitors.



ENHANCED GAMEPLAY EXPERIENCE

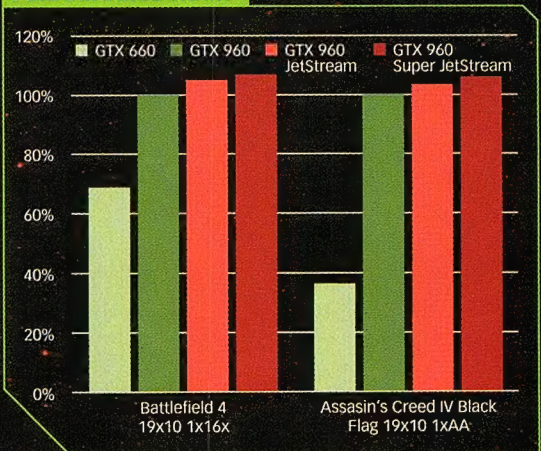
NVIDIA GameWorks lets gamers change the settings of Ubisoft games (e.g., adjust the graphical details of the shadows) to see unique visual and gameplay innovations.



Ultra

Percentage Closer Soft Shadows (PCSS)

PERFORMANCE CHART



technotes

» GEAR WE WANT



ORBITKEY

FROM \$29.95 | WWW.ORBITKEY.COM

Hands up if you've ever sat down and stabbed yourself in the thigh with the bundle of keys shoved in your pocket. Or perhaps grimaced as you hear the jingle jangle of keys dragging across your smartphone screen? And ladies, how many lip glosses have come off second best inside your favourite handbag...

Key-rage begone! The nifty crowd-funded Orbitkey is designed to hold up to seven keys in a neat, aligned and sheathed bundle. Available in leather or colourful rubber materials you can also add on a bottle opener – no more 'lighter tricks' on your imported beers – or a USB drive in either 8GB or 32GB.

Melanie Pike

MAD CATZ S.U.R.F.R

\$85 | TINYURL.COM/K5Q7OLF

AVAILABLE: APRIL 2015

Covering both your browsing and gaming bases at once, the Mad Catz S.U.R.F.R is a gaming controller peripheral that aims to also let you comfortably browse the internet and control your media on Android-powered devices and smart TVs. Its unusual design houses a full QWERTY keyboard between dual analog sticks, with a D-pad surrounding the left stick and face buttons surrounding the right stick. Using the controller also gives you an on-screen cursor for browsing, and proper left and right-click functionality. It also has extendable grips and a clip to attach your Android smartphone for gaming when you're on the go.

Stephen Lambrechts



BRYDGEAIR

FROM \$220 | BRYDGEKEYBOARDS.COM

In an attempt to make an iPad Air keyboard case feel more like a laptop, Brydge Keyboards has made this case from a single piece of high-grade aluminium (much like MacBooks). It packs stereo speakers, backlit keys and a 180° folding hinge.

It's a premium price for an iPad case, but few match the look and feel of this one. We're fed up with plastic cases, so it's about time the iPad felt like a real laptop. There's one for each iPad Air colour type too, including gold for the iPad Air 2.





BEAM

US\$399 | BEAMLABSINC.COM

Meet Beam, a portable Android-powered projector that screws into a regular light socket to let you cast your smartphone or computer screen onto any surface. This awe-inspiring Kickstarter project already has almost \$600,000 worth of pledges and is expected to be shipping products by October. As well as screwing into any light or lamp socket, there's also a fabric power cord for direct connection to an outlet. Some of the pitched capabilities sound pretty incredible – such as setting up a video message to play in the hallway when your roommate gets home – and Beam even comes with white LED lighting options, so when it's not projecting it'll work as a normal light too.

Joel Burgess

COCOON HOME SECURITY DEVICE

US\$399 | COCOON.LIFE

Keeping your home safe is about to get a welcome boost with the stylish new Cocoon device. It comes with a motion sensor that's meant to avoid pet-triggered false alarms. It also uses low frequency noise sensors to detect unusual movement on other floors or in other rooms. All this can be controlled remotely using the paired app, while the Cocoon can send you alerts or contact the police if it detects anything untoward. Due for release in the US in late 2015, it's got amazing functionality, keeps you in the loop and looks pretty great too – what's not to love?



NEEO - THE THINKING REMOTE

US\$299 | NEEO.COM

Is this really it? The perfect universal remote control? The NEEO system includes a beautifully designed remote with a touchscreen and the Brain (that's what they call it), a puck that beams infrared in 360° to control AV equipment, along with Bluetooth, Wi-Fi and other wireless protocols for controlling... just about anything else, too. TV, speakers, connected home – the NEEO system should be able to control it all. There's an app for iOS that ties into the system too, naturally, so you can control a Brain from your phone and... hmmm, this suddenly sounds like a supervillain plot, doesn't it?



Democratising virtual reality

With OSVR, Razer is attempting to democratise virtual reality in order to secure the technology's future in games.

OSVR, or Open Source Virtual Reality, is the only thing standing between the nascent VR market and a premature death, at least if Chris Mitchell, Razer's product marketing manager, is to be believed. In his own words: "If we don't build this, the virtual reality ecosystem will never survive." It's big talk for a project that, even after a press release, media briefing and one-on-one interview with Razer, still feels nebulous.

Razer, of course, made its name with gaming peripherals, ergonomic gaming mice and keyboards, but OSVR is not so tangible. The company's plans do include hardware: a \$200 head-mounted display, which it calls the Hacker Dev Kit, is due mid year, and measures up reasonably with the Oculus Rift DK2 unit. But the Dev Kit is not OSVR exactly – it's a malleable headset meant to spur development of VR games. OSVR is actually a software platform. Led by Razer and headset maker Sensics, the aim is to make game development for VR devices more about the game, less about the hardware you have. Creators will be able to hook into plugins for how a game should look on one head-mounted display versus another, or how it should pull in data from various motion-tracking systems. And with a library of such plugins, developers won't have to be Carmack-level engineers to get a game running in VR.

As Mitchell says, "The idea is to

abstract the complexities of game development right now. We need a forum for developers to focus on the content and not worry about the actual execution of how to do it."

So how does OSVR accomplish this? Sensics CEO Yuval Boger offers the clearest explanation on his VR Guy blog: "OSVR provides software plugins (think: device drivers) for hardware that abstracts each type of hardware – such as head orientation trackers, position trackers, eye trackers – and makes the interface the same for the higher-level application. While the performance of different position trackers may be different, the interface to the application is basically the same. While some eye trackers are better than others, the application usually just needs to know gaze direction, blink detection and perhaps pupil size. By abstracting each type of hardware, the application does not need to change when new hardware becomes available. All it needs is a new plugin, the equivalent of a printer driver."

OSVR already supports Unity and Unreal Engine 4, which will allow developers using those engines to interface their games with various forms of VR hardware. Razer claims some big names are already behind OSVR, too – developers such as Gearbox and Techland, plus hardware makers Virtuix, Leap Motion and Sixense – though it's unclear what all these companies are doing to support OSVR exactly.

Leap Motion, which creates PC motion and gesture control technology, offers a degree of insight. "Earlier this month, we announced a Leap Motion plugin for OSVR," says CEO Michael Buckwald. "In recent months, we've also demonstrated how our technology pairs with Oculus Rift and Samsung Gear VR, in addition to OSVR... We launched our VR Developer Mount last August, [which] provides a consistent way for developers to guide interaction, and it works with any VR headset with a flat front surface and a setup supported by our SDK."

Virtuix, creator of the Omni treadmill, offers a similar response. "We're mainly focused on the movement aspect of VR – how can a user walk or run around in the virtual world," says CEO Jan Goetgeluk. "In its basic form, the Omni emulates a typical gamepad that steers the avatar in the game. However, with the Omni, more advanced movement functions can be provided as well – one-to-one foot tracking, fully decoupled movements, advanced gestures, and more. Our contribution to OSVR is the development of a locomotion controller for VR that supports this range of motion functions."

Both are doing what's best for their VR products, in other words. Which isn't a bad thing – if it's easy to get on board with OSVR, the platform is more likely to benefit developers. But it's also unclear exactly how open and accessible OSVR is. Its web site features a big orange 'Join us' button, and asks interested parties to sign up to be

involved in the project. But there's no publicly visible development community for OSVR. There are no forums, official subreddit, or github repositories, all standard for active open source communities. Surely those will come, but an application process as a barrier to entry may result in only more serious developers joining.

"OSVR is still at a very early stage, although it is usable right now," Mitchell says. "The end goal is to make it so simple that developers would not have to spend much on writing code. We also hope to get contributions from the community so that when new devices come out, we don't have to be the first to implement it. The community can add support [itself]. We're not there yet. It's fair to say we're at an alpha stage. But it's a working alpha."

OSVR's end goal of hardware-agnostic VR development pointedly proposes there will be an array of VR hardware outside of Oculus Rift. It assumes that the consumer Oculus Rift headset will be a flavour of VR hardware rather than a platform unto itself. And yet there is currently no serious competitor for Oculus Rift bar Sony's Project Morpheus, which targets a very different platform. And OSVR likely won't support Morpheus, because it's removed from its supported OSs of Windows, Linux and Android.

So is OSVR, or something like it, truly integral to the survival of VR? Or, at least, integral to the growth and prosperity of VR as a medium?

That might be pushing it. However, Buckwald points out that OSVR is a big plus for OEMs, which will potentially be able to build VR hardware that stands a chance of success in the market a few years from now. Without any OEMs in the picture, the VR hardware market may end up being small, featuring just Oculus and Sony alongside a few much smaller companies unable to compete.

Razer's relationship to Oculus VR in all this seems strange, too. According to Razer, the OSVR SDK already supports Rift DK2, so there's no real reason for developers to make VR games exclusively with Oculus APIs when they could develop for a broader range of hardware and support Rift, too. But according to Sensics CEO Boger in a Reddit Ask Me Anything focused on OSVR, the company didn't attempt to get Oculus on board before the launch. "We did not contact Oculus prior to announcing OSVR but would welcome their contribution and participation in it," Boger said. "We are not anti-Oculus. We are pro-VR, and Oculus has an important part to play in the pro-VR movement."

Razer and Sensics may not be trying to compete with Oculus VR directly, but OSVR's founders aren't going out of their way to work with Oculus, either. There's another concern, too: when it comes to

AR, she blows

While Oculus Rift competitors were absent at CES 2015, several augmented reality headsets were on display. Where virtual reality HMDs aim to completely immerse you in a virtual world, AR headsets typically use a transparent display to layer information atop the real world. Gaming is, at least currently, in the realm of VR, not AR.

CastAR, funded by a 2013 Kickstarter from engineers who worked on VR at Valve, was at CES with hardware that's on its way to campaign backers. CastAR is the smallest HMD (AR or VR) we've seen to date, looking like a chunkier Google Glass than a Rift. The flashiest AR headset at CES, by comparison, was Caputer Labs' Seer, looking like a cross between Nintendo's Virtual Boy and a motorcycle helmet.

The Seer headset runs off a smartphone, but unlike Oculus and Samsung's GearVR, the smartphone screen doesn't sit right in front of your face. Instead, it slots into the headset and has its screen reflected onto a visor, which gives you an AR overlay. Seer is an early prototype, with imminent plans for a Kickstarter campaign.

slightly nebulous projects debuted at CES, history is not on Razer's side. At CES 2011, it introduced Switch Blade, a portable gaming system with dynamic LED keys. It won Best Of CES awards, but was never sold outside of China. At CES 2014, Razer introduced Project Christine, a modular gaming PC system. It won Best Of CES awards, but shows no signs of ever becoming a real product. Razer's Hydra motion controller, another CES darling, is no longer on sale. Razer is, however, using Hydra to demonstrate VR, and we may see the controller returning in some form in the future.

OSVR, then, should be viewed with some scepticism. But unlike Switch Blade or Project Christine, which were never likely to be big sellers for Razer, OSVR represents a gateway to build a popular VR peripheral – perhaps even the de facto input device for VR gaming, which is still a crucial unsolved problem.

"On the peripheral side and the HMD [head-mounted display] side, there's a ton of different technologies being thrown around, and it's very difficult to figure out what is the best technology for each of those things," Mitchell says. "Once we roll [OSVR] out and it's in the market for a while, we'll see the community coming in and trying

different technologies. That's when we figure out what's the best technology to then bring into the consumer space, which is our ultimate goal... Ultimately, what we're interested in is making virtual reality a reality. [That sounds] cliché and cheesy as hell, but that's what we want to do. Get it to the consumer space, get it ready, and for us, because we're not entirely altruistic, [the aim] is to be part of the ecosystem on the peripheral side of things. It's not crucial for us to be in the HMD space."

Razer's longest-lasting contribution to VR is most likely to be that inevitable peripheral, then: something combining Razer's research into VR, its Hydra, and more than a decade of experience making gaming mice. In a way, that would solve a problem much like OSVR aims to. The sooner we figure out the best way to control VR, the sooner developers can VR games that use it. ■

"We need a forum for developers to focus on the content and not worry about the actual execution."





Cyber razer cut

How does the OSVR Hacker Dev Kit stand up?

While Oculus VR's Crescent Bay prototype is the near-future of VR, Razer's \$200 Hacker Dev Kit, shipping in June, looks very much the present. Putting it on is a lot like wearing an Oculus DK2. The 1080p screen is high enough in resolution to be workable, but the pixel grid is prominent. Magnifying lenses sit between your eyes and the display, and require a little fiddling to be put into focus. Refresh rate, meanwhile, isn't sickening, but it's not as smooth as Crescent Bay, either. And there's no positional tracking in space, which Crescent Bay has by virtue of an external camera.

Razer has made some smart decisions in the design of its Dev Kit, though, with lens controls allowing users to adjust their focus easily. And while it wasn't being demoed at CES, Razer's hardware will be configurable and upgradeable: developers will be able to swap out the optics, the display, or most other components to create a different headset. It all fits neatly into Razer's plan to spur hardware-agnostic development of VR games.

At CES, Razer demoed the Hacker Dev Kit with a LeapMotion camera clipped onto the front. The camera picks up hand motions and maps them in-game, allowing you to move your real hands around and mime throwing fireballs at a target that floats around a snowy woodscape. It proves hard to aim

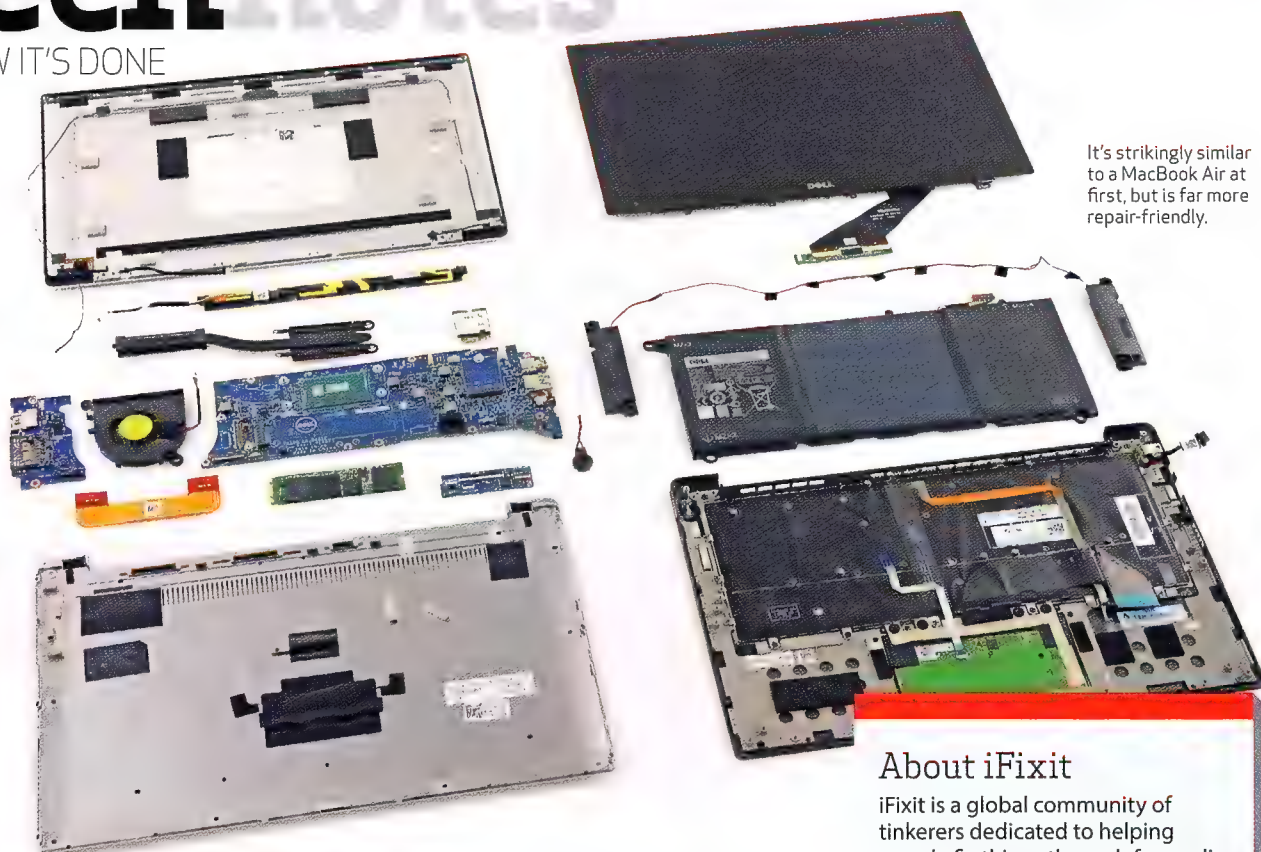
and track a moving object in three-dimensional space, especially given the delay between physical and digital action. And the demo itself isn't a game that would sell anyone on VR (unless being a goalkeeper in Kinect Sports sold you on Kinect — in which case, get ready to fall in love). But it does showcase the immersive potential of motion sensing in VR. When the technology improves, a game such as *Myst* could work beautifully in VR with nothing but motion controls. ■

"Razer has made some smart decisions in the design of its Dev Kit."



technotes

HOW IT'S DONE



It's strikingly similar to a MacBook Air at first, but is far more repair-friendly.

Dell XPS 13 (2015)

Dell makes it fit.

Thirteen doesn't go into 11. It's simple math. Unless you're Dell, in which case you laugh in the face of impossible calculations, and drop ice cubes down the vest of differential equations. Or something. What we're getting at is Dell's claim to have squeezed a 13-inch display into an 11-inch notebook form factor. How is such devilry achieved? By ditching the screen bezel almost entirely, that's how.

MAJOR TECH SPECS

- 13.3-inch "UltraSharp QHD+ infinity touch display" with 3,200 x 1,800 resolution
- Fifth-generation Intel Core i5-5200U processor (up to 2.7GHz) with Intel HD Graphics 5500
- 8GB Dual Channel DDR3L-RS 1,600MHz RAM
- 128GB SSD
- Four-cell, 7.4 V, 52W battery with "up to 11 hours run time."
- Broadcom DW1560 Wi-Fi/Bluetooth 4.0 LE card

KEY FINDINGS

- Dell gives up bezels and shaves the case width for portability and to

highlight the "infinite" display and full-size keyboard. Requiring two different drivers just to get the thing open has us scratching our heads, but at least we've got screws! That's better than the alternatives. We spoke too soon — there are clips, too, and hefty ones at that.

- This looks like a less-polished MacBook Air. Similar except for the repair-friendly labels on every component and connector, something you don't ever see in an Apple product.
- The battery connector is no easy pop-off top; it requires some precision spudgering to chase it out. After that, it still isn't a perfectly clean getaway — the speaker wires



About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

are strategically taped to the battery in a half dozen spots.

- Let's get to the fun part, the new exciting feature Dell is trying to sell here — the ultra high-def, infinity-edged touchscreen display. The clutch cover comes off, revealing a plastic frame of antennas. You'd better peel slowly and use plenty of heat. That's some thin glass.
- After painstakingly cracking the clam, we find a mysterious black thread running along the inside of the top case. There's no mention in the manual, but we're betting we just stumbled onto the easy way to get the LCD out—without the pain or the staking. What an awesome repair Easter egg!
- Repairability Score: 7 out of 10 (10 is easiest to repair). Free service manuals are online. Once you get the bottom cover off, all the parts are pretty easily replaceable. Screws and connectors are labelled. Moderate adhesive — except for the display assembly, so no heat is required. The layering could be better, but the modular design makes repairs cheaper. Soldered RAM means that can't be upgraded.

technotes

» EPINIONS

```
Calculate Pi - how many iterations: 1000000
Pi to 1000000 iterations = 3.1415936535887745
Pi to 1000000 iterations = 3.1415936535887745
BUILD SUCCESSFUL (total time: 11 seconds)
```

YOU CALL THAT A PI?

In the output of Pi on page 107 of the January issue, I was wondering if that was the best that Java could do, as sadly it has gotten Pi wrong.

The shown output of 3.1415936535887745 is incorrect. The correct value is 3.1415926535897932 (taking it to the same decimal place). Or to use an inverse trigonometric function in the code, $\text{Pi} = 4 * \text{the arctangent of } 1$.

But, not being a Java programmer, maybe the language can't handle it, or perhaps it was a simple typo?

Mark Ahern

Darren Yates replies: No, that's not Java's fault. As I think I may have mentioned in the article, there are many ways of calculating Pi. Java even has its own function in the Maths library called Math.PI. However, I wanted to show some basic mathematics you could do and calculate Pi manually via simple code. The Gregory-Leibniz series I used is the simplest one to code from scratch. And yep, its problem is that it's only accurate to five decimal places, but it was in keeping with the level of Java instructions we've covered so far.

Nilakantha's Pi series works better/faster but is more complicated and you could always just choose Chudnovsky's series, but I dare imagine we would've lost almost every reader trying to explain how that one works!

With these other formulas and a data type we haven't covered yet called 'BigInteger', Java can calculate Pi to as

"It should probably be reclassified as 'it flukes Pi to 5 decimal places!' Let's hope NASA never uses it in a slingshot manoeuvre around Neptune."

many decimal points as you want, we just haven't got that far into the series yet!

Mark Ahern replies: Thanks for the quick and comprehensive reply. I understand the 'coding angle' of the series and you're right, it's a good base to start. But purely from a scientific angle, if the Gregory-Leibniz formula is only correct to 5 decimal places, it should probably be reclassified as 'it flukes Pi to 5 decimal places!'

Let's hope NASA never uses it in a slingshot manoeuvre around Neptune.

BUILDERS GUIDE?

I've seen a great feature in the back of other magazines where they keep a running tally of the best products they've reviewed across multiple categories (case, graphics, power supplies, networking, storage, monitors etc). They also present what they think are the best components for a selection of builds (work PC, gaming PC, multi-threaded workstation, mini-ITX).

It's a great way to stay on top of the best products they've reviewed. It's also great when you are preparing to build a PC.

I'm just wondering if you have ever included, or considered including something similar?

Gareth

Ed replies: A quick-reference buyer's guide is something we've had in APC previously and we are in the process of considering how best to bring it back (without taking up too many of our precious pages each month!). In the meantime, we'll have a more comprehensive PC Builder's special next month, with parts recommendations and PC-building how-tos.

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Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

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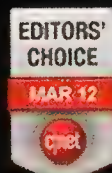
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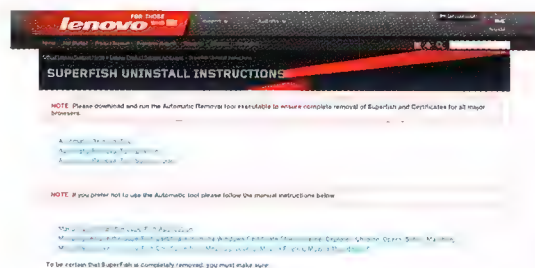


gameinformer



technotes

END USER



Lenovo laptops hooked

Superfish adware installed on laptops right out of the box.

A scandal has rocked computer technology company Lenovo after it was revealed in late-February that many Lenovo consumer laptops had shipped with pre-installed Superfish adware, which essentially performs malicious man-in-the-middle attacks on your web searches. Superfish injects ads from third parties into your Google searches and web sites, while also decrypting and hijacking the secure certificates in the computer's SSL (Secure Sockets Layer), spying on your internet traffic and potentially leaving your private information open to hackers — everything from banking information, emails and passwords are up for grabs once Superfish has sunk its teeth into you.

So why would Lenovo want to put its customers' digital lives at risk? According to Peter Hortensius, Lenovo's Chief Technology Officer, the company had no idea the adware would compromise its customers' secure data, saying "the intent was to supplement the shopping experience." We're not sure which is worse — Lenovo performing these kinds of adware practices in the first place, or the CTO of a global computer manufacturer admitting to not having a real grasp of the dangers this kind of software could present. In either scenario, it isn't good.

Lenovo has since teamed up with McAfee and Microsoft to develop a Superfish removal tool, which it has

now released and should completely remove the software from affected computers. So abhorrent is the Superfish adware, that even the U.S. Department of Homeland Security issued its own guide to removing it, warning of the "critical vulnerability" that Superfish leaves people's computers open to.

Typically, a user must agree to authorise any root certificate additions in their local certificate store, which is why Lenovo's pre-installed inclusion of Superfish feels so sneaky and unethical — users aren't even made aware of the privacy they're giving up.

For now, Lenovo is going to have to work hard to regain the public's trust after this debacle. While the company

has apologised, saying that "customer experience, security and privacy" must be its "top priorities", and that it vows to "significantly reduce preloaded applications", not everyone is entirely convinced — Lenovo's web site was the victim of a cyberattack just days after the company made the public apology, with notorious hacking outfit Lizard Squad claiming responsibility for the hack.

Lenovo is offering anyone that has been affected by the Superfish adware a free six-month subscription to McAfee's LiveSafe protection software. Whether that's enough to placate unhappy Lenovo customers is another story entirely.

Stephen Lambrechts

Addendum 'Why pro reviews matter' revisited

How to tell if Amazon reviews are fakes.

FAKESPOT.COM/

Continuing our discussion on the reliability of professional and user reviews (see APC January, page 14), a web site called Fakespot has emerged that aims to help people make more informed purchasing decisions by spotting fake reviews on Amazon.com.

Simply post an Amazon product URL into the site's search bar and Fakespot will use its automated algorithm to analyse the accounts that the product's reviews come from, checking whether they were generated by automation, or if the account has actually purchased the product it's reviewing.

Fakespot will then apply a letter grade to the product page, and also show the percentage of reviews detected as 'fake'. ■

ENDUSER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.



4K Graphics

4th gen Intel® Core™ processors,
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Dual Bay

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Perfect Audio

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premium sound



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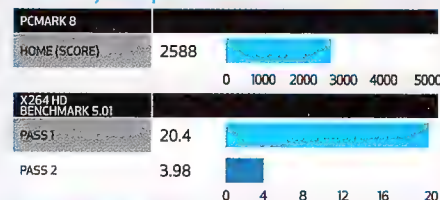


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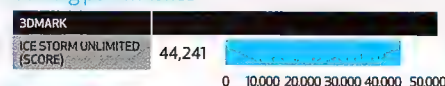
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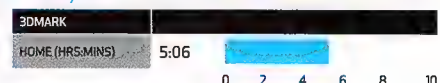
General system performance



Gaming performance



Battery life



Toshiba Portégé Z20t

The Windows tablet/laptop hybrid to beat.

You can appreciate the irony: right when tablet sales are flagging, along comes what's possibly the best Windows tablet we've ever seen. As good as Microsoft's flagship Surface 3 tablet is, it's still a bit of a compromise – it's a bit too thick and heavy for a tablet and not as happy to sit on your lap as a genuine laptop. The Portégé Z20t, on the other hand, works a little better as a tablet and is a little more sturdy as a laptop – though the trade off is that it's not quite as portable as a whole.

Like the Surface, the Z20t defies a lot of conventions – and it's really all about options. Like many other tablet/laptop hybrids, it splits into two discrete parts, with the screen section coming away from the keyboard base to act as a standalone tablet. And as a tablet, it's one of the best Windows devices we've used – that 12.5-inch matte-finish IPS touchscreen is gorgeous, with deep and rich

colours, and its 700g weight means you can comfortably (just) hold it in one hand.

The keyboard base houses a second battery combined with a nice big touchpad and a frankly great keyboard – it's the perfect balance of key throw height, resistance and quietness. There's also a good compliment of ports – VGA, HDMI, two USB 3.0 and Gigabit Ethernet. And lastly, Toshiba's included a generous, pen-sized stylus that's thick enough to be comfortable in the hand – although that size does mean there's nowhere to stow it in the body of the device.

WHAT'S INSIDE?

The internals of the Z20t also bear a mention. This is the first device we've seen that's based on Intel's new Core M platform, which the chip giant is hoping will help it build both low-power laptops and powerful tablets at cheaper prices. Core M's big advantage is that its extremely adaptable – it can run in a very low-power

mode when doing light work, or ramp right up for more demanding tasks.

In the Z20t's case, there's a Core M-5Y71 CPU under the hood, which can operate between 1.2GHz-2.9GHz. With the keyboard base's extra battery, that flexible CPU lead the whole kit to last almost 10 hours (9:47hr to be exact) in our tough PCMark 8 Home test, which mixes together media playback, gaming, web surfing and productivity tasks. That's an outstanding result. On its own, the tablet didn't quite fare as well, lasting 5:06hr. But the benefit is that, in use, the Z20t never feels sluggish. And when needed, it can offer quite a bit of speed – there's even just enough grunt in the Intel HD Graphics GPU to do modern gaming at playable frame rates... provided you're willing to play at 720p and turn the details down a bit.

This isn't quite the perfect mating of laptop and tablet. The keyboard base is a bit too thick for our liking and

it doubles the carry weight to 1.47kg (though that's arguably a fair price to pay for having an extra battery inside). And the design of the hinge area where the tablet gets plugged in is, while functionally sound, a little bit awkward in use.

It's hard to deny the charms offered by the Z20t's extreme flexibility, though. This is a device that works respectably well as both a tablet and a laptop, with a solid, well-considered design. If you're thinking of buying a 2-in-1, this should definitely be on your list.

■ Dan Gardiner

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A 2-in-1 that's actually comfortably usable in both its forms. Great battery life too.

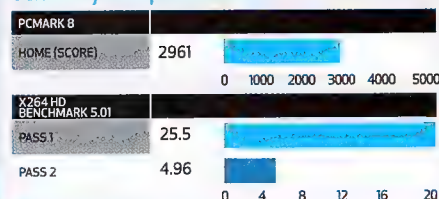




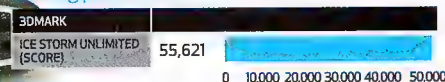
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LABS BENCHMARK RESULTS

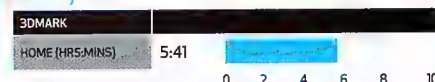
General system performance



Gaming performance



Battery life



Dell XPS 13 (2015)

Has Windows finally got its MacBook Air killer?

The second laptop we're reviewing this month isn't quite as revolutionary as the Toshiba unit at left, but it's arguably a better-focused product that knows what it wants to do – and aims to do it well.

Dell's new XPS 13 ultrabook has been widely described as a 'MacBook Air killer' in overseas media, but it's actually different enough from Apple's design to have its own sort of appeal. It's both smaller and lighter than the Air, for starters, with the narrow bezel around the top and sides of the screen (just a few mm wide) helping shave down its overall footprint and weight, which is a tiny 1.18kg. Combined with an amply-sized trackpad, solid keyboard (with nice firm and tall keys) and a richly coloured, clean and sharp 13.3-inch display (even on the 1080p entry-level model we tested), this is an attractive little tool.

And it's an efficient one,

with battery life ranging from 5:41hr to 6:36hr in our pair of tough battery tests. In this 13-inch ultrabook form, we've only seen better from the MacBook Air itself – which stretch another half an hour in the latter test to 7:09hr. Regardless, under light to moderate workloads the XPS 13 should definitely last an 8-hour working day with battery to spare.

There are some nice little touches to the device too, like the row of five LED lights on the side that, at the tap of the small button next to them, will illuminate to show you roughly how much battery life you have left.

As the photos kind of give away, the XPS 13's chassis isn't entirely constructed of metal; with only the top and bottom being machined aluminium. Inside is a soft-touch black carbon fibre material that's arguably more comfortable than metal to rest your palms on. Whatever the case, this is still a very tough little machine that

should be able to take some punishment.

Are there things we don't like about the XPS 13? Certainly – but they're all fairly minor. For example, coming directly from a MacBook Air, the Dell's 16:9 screen aspect ratio isn't quite as friendly as the Air's 16:10, which gives the latter a bit more vertical space. There's also the usual ultrabook drawback of limited ports: there's only two USBs (both 3.0), DisplayPort out, SD card and a 3.5mm headset socket.

Perhaps the most vexing element of the design is the odd placement of the webcam – it's under the bottom left corner of the display. It can make centring your face for chats a little bit tricky. It's something you're reminded of every time you open the laptop, as by default it'll use 'face unlock' software to verify your identity and unlock your account.

In all then, there's not much worth griping about. In fact, the main question

mark we have over the XPS 13 has to do with value. The equivalent 13-inch MacBook Air (with 128GB SSD and 4GB RAM) is a good \$300 cheaper at \$1,199 – and though the MacBook has a lower-res screen (1,440 x 900 compared to 1,920 x 1,080) it also has that full aluminium chassis making it look and feel a little more premium compared to the Dell's mixed metal and carbon fibre. This isn't out-and-out an Air killer then. That doesn't, however, stop it from being most appealing Windows alternative we've ever seen.

■ Dan Gardiner

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Different enough that it's hard to call this an Air killer, but one of the best compact Windows PCs regardless.





VIRTUAL REALITY HEADSET

\$249 | WWW.SAMSUNG.COM/AU

Samsung Gear VR

Use your smartphone for VR via Samsung's new headset.

In the still-emerging world of virtual reality, Samsung's Gear VR is a big deal: it's the first consumer-ready device to hit the market. This is still a beta product though, designed in partnership with Oculus VR using the same optical technology as the Oculus Rift. Plus the Gear VR requires the addition of a Galaxy Note 4 as a screen; there's no display of its own. So while the headset's quite affordable at \$249, the need for a \$900 Note 4 to pair it with means the whole exercise isn't cheap.

The design of the Gear VR sits somewhere between Oculus Rift DK 2 and Google Cardboard. The white plastic shell is moulded into the familiar ski-goggle headset design and even with the Note 4 inserted it doesn't feel too heavy, though the focus adjuster on the top might need a bit of tweaking, especially if you're a glasses wearer.

So, how the hell do you control the Gear VR if the

phone is inside it? Samsung offers two means of interaction: a touchpad and back button on the side of the headset, or an optional Android controller. Using the swipe-based touchpad is easy enough for navigating menus and interacting with some of the basic games and experiences, but you really need a controller to get the most out of Gear VR.

To create the optical illusion of VR the Note 4 display divides into two screens that blend together again when viewed through the lenses. But while undoubtedly impressive, the limitations of the Note 4 screen (even at 2,560 x 1,440 pixels) are still obvious. The resolution and latency are good, but limited by a device that wasn't primarily built for virtual reality.

In particularly vibrant worlds the pixels are still visible, creating a barrier to immersion that's hard to overlook. But in less colourful environments, such as Oculus Cinema, the Note 4's super deep blacks

are impressively authentic.

The UI is rather bare-bones, which isn't a bad thing. You've got the Home menu, the Library and the Store. Your most recently used apps will show on the Home screen, while the Library offers a complete list of all your downloads with the option to filter.

Jumping between menus is as simple as moving your head and tapping the touchpad, and just about everything can be done from within the headset.

We tried a number of different experiences, most of which were free and many of which required the optional controller to play. *Anshar Wars* lets you fly around in space and shoot aliens, while *James's Legacy: The Prologue* is a beautifully designed adventure game made of colourful, cuboid worlds. But perhaps our most memorable experience came from *Shooting Showdown*, a simple FPS that pits you against another random online player on a firing range. Despite the fact their

"body" was hidden on the other side of a dividing wall for the duration of our contest, there was something rather awesome about sharing a virtual space with another player.

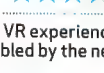
At present, the Gear VR's bigger drawback is that it relies entirely on having a Galaxy Note 4. Lets hope Samsung opens this up to more of its smartphones.

Right now though, it feels like a box of neat gimmicks and experiences, and it shows that virtual reality still has some way to go. But even as just a demo of what's to come, Gear VR is a fantastic showcase for this flourishing medium. It's hard not to be excited about, even if it's restricted to Note 4 owners.

■ Hugh Langley

Verdict

Features
Performance
Value



Can create convincing VR experiences, but it's somewhat hobbled by the need for a Note 4 to run it.





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GAMING LAPTOP

\$3,499 | WWW.ASUS.COM/AU

ASUS G751JY

In the face of powerful desktop parts powering other laptops, can ASUS's mobile gamer compete?

ASUS's G751JY is a hulking great beast of a machine. We're not just referring to it being a hefty 17.3-inch notebook weighing nearly 5kg – it's also packed full of the best mobile hardware money can buy. Which is lucky, considering the price.

The processor is top-end mobile Haswell fare, a quad-core Core i7 capable of running up to 3.5GHz in this chassis, with a huge 32GB of DDR3 memory, an M.2 512GB SSD (the Samsung XP941) with a 1TB hard drive and an Nvidia GTX 980M. The keyboard and trackpad are worthy of note too. There are extra macro keys and buttons to launch Steam's Big Picture and Nvidia's game streaming software, while the trackpad is wide and responsive, with a pair of discrete buttons.

For gaming, it's the range-topping Nvidia GPU

that will get all the plaudits, but the screen ASUS has used deserves a mention too. It's stunning. The 17.3-inch IPS panel has a native resolution of 1,920 x 1,080, but impressively runs at 75Hz. That's just 15Hz over the traditional 60Hz, but it makes a visible difference. Even before catching the numbers in the Nvidia settings screens, we'd been impressed with the clarity and smoothness. And it's no surprise it's the panel we've seen running a leaked mobile G-Sync driver to such good effect...

That GTX 980M though does help make the screen look good, hurling around textured, tessellated polygons at fantastic frame rates. It isn't quite on a par with the desktop GTX 980 we used with MSI's Gaming Dock two months back, running to about 75 to 80% of that full-fat graphics silicon. But that still makes it more than a match for any

1080p games you wish to throw at it, and thanks to the chilled-out Maxwell architecture, it runs seriously quiet too.

You've also got the ASUS chassis design to thank for that. The thin 'n' light movement is all well and good for the notebook you take into meetings or sit with on the sofa, but for a gaming laptop, packing components which really benefit from proper thermal attention, you need some girth in your chassis so you don't end up with the whining fans spinning up in a rushing cacophony.

The G751JY is whisper quiet even at full tilt, making it a great desktop replacement to use as a docked machine too. Plug in a keyboard and mouse, output to a decent monitor and you'd be hard-pushed to tell you weren't gaming on a full-fat tower PC.

And while we're comparing it with the MSI,

this chunky, powerful gaming laptop will last longer away from the plug socket too. The eight-cell battery, combined with the low-power Maxwell chip, managed over an hour of gaming before needing a charge.

ASUS's G751JY may not have the upgradeability or gaming power of the MSI's Gaming Dock, but right now this chunky machine is a much better option, both on the go and plugged into a desktop monitor.

■ Dave James

LABS BENCHMARK RESULTS

CINEBENCH R15	INDEX SCORE
ASUS G751	6.74
MSI GS30 W/DOCK	6.90
GIGABYTE P35X V3	6.94
	0 2 4 6 8 10
BIOSHOCK INFINITE	AVG FPS
ASUS G751	95
MSI GS30 W/DOCK	120
GIGABYTE P35X V3	86
	0 25 50 75 100 125
METRO: LAST LIGHT	AVG FPS
ASUS G751	42
MSI GS30 W/DOCK	53
GIGABYTE P35X V3	41
	0 25 50 75 100 125
SHADOW OF MORDOR	AVG FPS
ASUS G751	69
MSI GS30 W/DOCK	87
GIGABYTE P35X V3	65
	0 25 50 75 100 125

Verdict

Features
Performance
Value



Excellent gaming performance and screen; decent battery life; whisper quiet.





MINI PC

\$580 (BAREBONES) | WWW.GIGABYTE.COM.AU

Gigabyte BRIX GB-BXi5-5200

Why hello, Mr Broadwell...

Hold up, hold up. While Gigabyte's latest BRIX is technically rocking a new fifth-gen Core CPU, it's from the mobile U-series that Intel launched at January's CES.

The Core i5-5200U is a dual-core Broadwell chip with a TDP of just 15W, making it a great chip to fit inside a mini PC like this BRIX. Despite that lowly TDP, you're still getting an impressive amount of performance from this wee chip – it may be dual-core, but thanks to the magic of Hyperthreading that's split out into four threads of processing power. And at a steady 2.2-2.7GHz, the 5200U manages a decent rate of knots considering its low-power status. This isn't some workstation monster, then. You're not going to expect this BRIX to breeze through heavy rendering, extreme mathematics or calculate the answer to the

ultimate question. This is a tiny, fully fledged x86 PC that you could lose down the back of your TV if it wasn't bolted down. (It's probably for that exact reason Gigabyte has included a VESA mounting bracket.)

What does Broadwell in this guise get us then? After all, the previous i5-powered BRIX was rocking a Haswell 4200U CPU with the same chilled-out 15W TDP. Unsurprisingly for a die-shrinking Intel Tick, not a huge amount has actually changed with the switch from Haswell to Broadwell. The CPU architecture remains as with Haswell, except with the teeniest transistors now being cut down into a 14nm lithography. That shrink allows the i5-5200U to maintain the same TDP but significantly bump the clock from 1.6 to 2.2GHz.

But, as this is ostensibly a Tick+ in Intel parlance, the graphics side of the equation

has had rather more attention. Intel has improved the geometry and tessellation hardware in Broadwell's HD Graphics and the HD 5500 revision in this BRIX gets you an extra four execution units (EUs). What all that means is you're almost getting Haswell Iris Pro levels of gaming performance from this low-power part.

Admittedly that gaming prowess was when this barebones BRIX was kitted out with 16GB of DDR3L running at 1,600MHz, but it's still a pretty impressive feat. And it's almost silent even at full tilt. Dial things down in the graphics settings and drop to 720p and you'll be capable of some decent gaming here. It will also nail Steam's In-Home Streaming, though even the older BRIX models could do that.

The issue though is that it's still hugely expensive to put a decent BRIX machine

together. This barebones is \$580 – that gets you the wee chassis, fitted out with the motherboard and chip soldered onto it. You also get the wireless card attached, four USB 3.0 ports and a Gigabit Ethernet connection too. Add storage, memory and OS though and you're looking at over \$900.

That makes the BRIX a tough one to recommend outright. This sort of price that would net you a laptop with the same CPU and spec, so the BRIX looks a little less versatile by comparison.

■ Dave James

LABS BENCHMARK RESULTS

CINEBENCH R15	INDEX SCORE
GIGABYTE BRIX	259
MSI GS530	612

X264 V4.0	INDEX SCORE
GIGABYTE BRIX	16.18
MSI GS530	35.24

HEAVEN	AVG FPS
GIGABYTE BRIX	5.1
MSI GS530	5.9

BIOSHOCK INFINITE	AVG FPS
GIGABYTE BRIX	7
MSI GS530	9

GRID 2	AVG FPS
GIGABYTE BRIX	13
MSI GS530	18

Verdict

Features	★★★★☆
Performance	★★★★☆
Value	★★★★☆

Tiny; practically silent; responsive; decent integrated GPU performance.





CHROMEBOOK

\$589 | WWW.LENVO.COM/AU

Lenovo ThinkPad Yoga 11e

Is this Chromebook worth the cost of a 'proper' laptop?

The Yoga is one of the few Chromebooks on the market with a rugged exterior.

Designed for use in rough-and-tumble environments, it boasts rubberised edges and extra-strong hinges. At about \$600, however, the Yoga 11e is more than twice the price of most other Chromebooks. So is the added flexibility and durability worth the price?

The Yoga 11e sports the same minimalist aesthetic as other ThinkPads, featuring a matte black plastic chassis. At 1.5kg, it's a bit heavier than most Chromebooks, but still light enough to be portable. As with other Yoga devices, the lid of the 11e can rotate 360° to lie flush against the bottom of the laptop. This design lets you use the device in four modes: traditional laptop, tablet (folded backward), stand (placed keys-down on the

table) and tent mode. This final mode sees the Chromebook at a 270° angle, standing on the edges of its lid and base. Rotating the screen automatically disables the keys.

While the Yoga 11e is comfortable to hold as a tablet, its utility in this mode is limited. The Chrome OS interface features dense clusters of small buttons, particularly in the upper right corner of the browser, that are tricky to use via touch accurately.

Multitasking is where this Chromebook runs up against its limited hardware. Using Google Docs while streaming music with a dozen other tabs open, for example, the audio occasionally stutters. Worse even, periodically there are half-second delays after pressing on the arrow keys.

Thankfully, the Yoga 11e's 11.6-inch, 1,366 x 768 touchscreen delivers bright and crisp visuals. Colours

popped when watching HD video, and text looked sharp on web sites. However, the viewing angles are shallow: moving more than a foot to either side of the screen, colours begin to wash out.

The touchscreen responds promptly to your input, and had no problem with pinch-to-zoom. The notebook's rear-facing speakers pumped out surprisingly well-balanced and loud audio.

We've come to expect an outstanding typing experience when using a ThinkPad, and this doesn't disappoint. The island-style keys offer plenty of vertical travel and tactile feedback, and the textured surface makes it easy to touch type. The touchpad is large and responsive, and the scrolling is easy using two fingers, while the cursor accurately tracks finger movement across the pad. Battery life is a letdown, however. The Yoga 11e falls short of

competing Chromebooks. With the brightness at 30%, a dozen tabs open and streaming music, the Yoga lasted 6 hours and 21 minutes.

The Lenovo Chromebook is more than twice as expensive as many Chrome OS-powered laptops. Still, it's one of very few Chromebooks that's a true 2-in-1 laptop. Plus, the Yoga's ruggedised exterior will help it endure the wear and tear of life.

■ David Eitelbach

Verdict

Features
Performance
Value



A rugged and flexible design with an excellent keyboard. If only the Yoga 11e didn't cost so much.





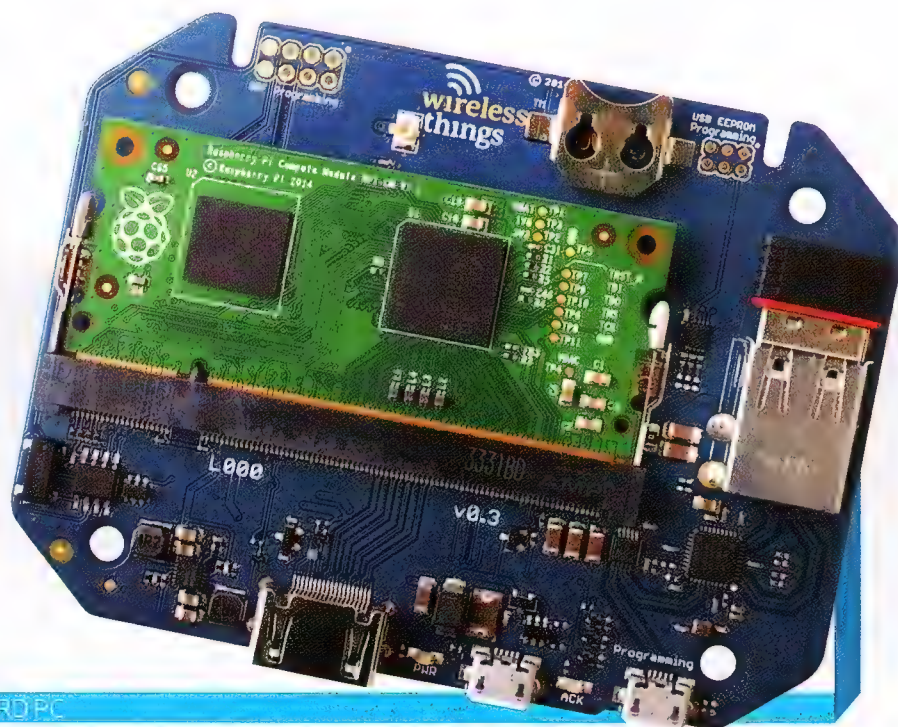
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Wireless Things OpenPi

A Pi-powered Internet of Things hub that you can redesign yourself.

Wireless Things is the new name for Ciseco, the Nottingham-based Internet of Things company responsible for the critically acclaimed EVE Alpha device. EVE is a compact device that fits snugly on top a Raspberry Pi, connecting via the GPIO pins. There are a plethora of modules that can be fitted to the EVE board: SRF or RFM12B radios, real-time clocks (RTCs), temperature sensors and more. With the OpenPi, Wireless Things hopes to take this idea one step further and it's just after the crowdfunder as we write this (tinyurl.com/414kick).

Using the Raspberry Pi Compute Module as a base, OpenPi provides two USB ports, a RTC (battery is included), 868-915 MHz SRF transceiver (for long range serial connections) and a temperature sensor. All this

is boxed up in a tidy plastic case, with apertures allowing HDMI and power connections. In terms of extensibility, you get 18 (plus two power) GPIO pins (which you'll need to break out yourself), headers for SRF and USB EEPROM programming, as well as wire-by-hand pins for connection to Wireless Things' XBee module. The Compute Module has 4GB eMMC storage onboard which houses a mostly-standard Raspbian install but this can be reflashed.

For the hobbyist user, it could be that a humble, standard issue Raspberry Pi will do the job, you can add the transceiver and RTC and any other peripherals easily and cheaply. It may not be a very tidy arrangement, but you can probably Macgyver yourself a suitable container using Lego, gaffer tape or a cigarette packet. A single basic OpenPi pack (comprised of just the Pi

Compute module and OpenPi PCB mounted in a case) costs £49, so it comes down to whether having it all in a convenient box is valuable.

What's unique about OpenPi is that all the board schematics are open source – you can download them as EagleCAD files. In so doing, OpenPi aims to make it easier to make the Compute Module a more flexible platform upon which to develop projects and products. Manufacturer research suggests that form is as important as function, and that this partly explains the hitherto lacklustre uptake of the Compute Module as a platform. They claim that while no single design will suit everyone, using the OpenPi as a reference point will greatly simplify the design process for any budding IoT builder. So the product is really targeting those with ideas and industrial aspirations.

Quantity discounts are available which speaks to this, but also makes the device more for educators.

We found that getting access to the RTC on our prototype required loading a module and sending some bytes to the i2c bus. The thermal sensor can easily be queried with `i2cget`, but the raw sensor data needs to be re-ordered and scaled to give correct reading. These are things that will be addressed come launch, which is planned for the end of March.

■ Jonni Bidwell

Verdict

Features
Performance
Value



A bold step conceptually, which will excite those with big ideas. But home users may prefer existing tools.





EXTERNAL DRIVE
\$499 | WWW.SAMSUNG.COM/AU

Samsung Portable SSD T1

The fastest external drive we've ever seen.

Storage isn't sexy. For all the SSD advances of the last few years, it's still difficult to talk about PC storage in any way other than terms of functionality. We all want our PCs to boot from SSDs because of their in-OS speed, but they're not really going to make games perform better or look more awesome. We're still always going to prioritise a quality graphics card.

But that's not to say things aren't interesting in the world of the SSD. It's one of the youngest areas of computing and has seen constant improvements as new tech, new controllers and new memory have arrived, boosting performance and reliability.

Samsung in particular has been riding the market mighty hard and is doing a damn fine job of making it very difficult to recommend anyone else's drives. And now the company's split out

into the external market, too, with this new Portable SSD T1.

It's rather tough to get across just how small this drive is. When we first saw the initial images from CES in January, we weren't that impressed. Cut a few days forward to us receiving our sample in the lab and we're slack-jawed and drooling like the magpie-eyed geeks we are. It's almost exactly half the size of a 2.5-inch SSD. But the real kicker is it performs almost as quickly as most SATA 6Gbps drives.

In the SSD-taxing AS SSD benchmark we recorded average read and write speeds of 420 and 406MB/s respectively. That's seriously quick for an external drive, and the random 4K results were almost as impressive, hitting 23 and 37MB/s for its read/write performance. That's faster than the current SandForce-powered SSDs. You could

theoretically run your OS from this drive and see little difference between it and a modern internal SSD.

This is over a simple, short USB 3.0 cable too. There's no magic to the 5Gbps USB 3.0 cable, we hit identical drive performance using a third-party cable from another USB 3.0 external drive. We say this because our worry was that Samsung had hocus-pocused the cabling somehow and we'd be royally screwed losing it, but thankfully that isn't the case.

We're used to using external SSDs over USB 3.0, as we run our benchmarking suite from an SSD using a SATA 6Gbps to USB 3.0 adapter cable and that's provided a speedy storage option that has been a mainstay in our testing suite. Our love has shifted though, as that drive is only half as fast as this super-speedy Sammy drive.

The big problem is that performance costs a pretty penny. This 500GB version is \$499 and the 250GB version is still around \$280, albeit with the same performance. That's a huge amount to pay for external storage. But for the pro-crowd, those needing to regularly transfer big files, that spend may just be worth it.

■ Dave James



Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A super-quick, tiny, lightweight and robust external drive, but a costly one.





MULTIFUNCTION INKJET PRINTER

\$180 | WWW.HP.COM.AU

HP OfficeJet Pro 6830

A budget colour all-in-one for the small business and home office.

This is an all-in-one printer, scanner, copier, and yes, fax machine, that comes in at less than \$200. But, and it's a fairly big but, the OfficeJet Pro 6830 does have its limitations and may not actually be the bargain it appears to be.

The OfficeJet Pro 6830 is a sturdy and compact device. It's based around an HP thermal inkjet engine capable of printing up to 18 pages per minute (ppm) in black and white and 10ppm in colour. Four separate ink cartridges are used and there's a max res of 600 x 1200dpi for both mono and colour output. An automatic duplexer is also built-in for double-sided printing, and there's a single 225-sheet A4 input tray with a 60-sheet output tray in its cover.

The 1200dpi scanner sits just above the print engine with an automatic document feeder (ADF) on top, which can be lifted up to allow

originals to be scanned manually (although on this model scanning is single-side only). A 2.66-in colour touchscreen allows for walk-up scan/copy/fax operation and there's a front-mounted USB port for printing and scanning to and from a memory stick, as well as options to scan remotely from a browser.

Unpacking and putting the OfficeJet Pro to work was a quick and easy task, all done from the built-in touchscreen over a Wi-Fi connection and taking around 10 minutes.

In terms of speed, we had around 4-5ppm for mixed text and graphics documents, and up to 10ppm for pure text, with the first page typically appearing in around 15 seconds. Quality was good enough for most business needs, but we did see lines appear when printing photos and other images, and the finished documents came out a little

wet, wrinkling when dry. Another irritation was the single paper tray soon ran out and was fiddly to refill, plus there was a pronounced pause between sides when using the duplexer and our finished documents often overflowed from the catch tray onto the floor.

We mostly printed over a Wi-Fi network although you can also print directly using a point-to-point wireless connection or via the HP Connected portal simply by emailing documents to the address assigned. Mobile printing is also well-catered for on both iOS and Android platforms and hard to fault on a printer in this price bracket.

Other than paper handling, our main concern was how quickly the ink was used up – the three colours (cyan, yellow and magenta) were exhausted after just 80 pages. However, that was with low-capacity starter cartridges and we did print

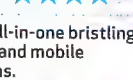
a lot of images. High-capacity replacement cartridges are available

Despite its low price and lack of size, the OfficeJet Pro 6830 is bristling with connectivity options plus a full complement of mobile printing and scanning tools that were highly effective. It's also a very easy device to operate, both via the colour front panel and remotely through either a browser or using custom apps.

The single paper tray is, however, a real drawback when it comes to high-print volumes and sharing.

Verdict

Features
Performance
Value



A quick inexpensive all-in-one bristling with print, copy, scan and mobile colour-printing options.



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"What kind of beast could this be to justify its price tag?"

EXTERNAL SOUND CARD

\$400 | WWW.CREATIVE.COM

Creative Labs Sound Blaster X7

The gold-plated kitchen sink of soundcards.

In the constantly shifting landscape of PC tech, soundcards have risked becoming a footnote, like dial-up modems and network adapter cards before them. When a system seller like Dell or HP can shave even \$20 off a build, it can shift the balance of power in a world of razor-thin margins. So when someone drops a device like the Sound Blaster X7 on us, it's almost disorienting. It's a \$400 audio station, when people can buy entire PCs for that much money. Creative Labs faces an uphill battle. What kind of beast could this be to justify its price tag?

At the heart of the X7 is the company's top-end ZxR soundcard. It features four digital signal processors on one die, a Burr-Brown PCM1794 127dB digital-to-analog converter, a Texas Instruments PCM4220 analog-to-digital converter,

and a TI TPA6120A2 headphone amp capable of driving 600-ohm cans (with a 1/4 and 1/8-inch jack available on the front). That gear might not sound familiar, but it's top of the line in digital audio.

Out of the box, the X7 will drive two speakers at up to 38 watts, and an optional power brick can push that to 100 watts. It connects to your PC with a bundled micro-USB connection, and has a full-sized USB port to act as a host for another device, like a mobile phone or tablet. If that's not enough, the X7 has optical audio in and out. And you can adjust its settings with an Android or iPhone app via Bluetooth and NFC. And besides the microphone jack, there's also an integrated beamforming mic. The X7 will do echo cancellation and noise reduction and let you fine-tune the beam width.

We could talk all day about the features inside this box.

Suffice it to say that it's a kitchen sink for audiophiles. The X7 also has Crystalizer, virtual surround sound, a loudness cutoff for nighttime viewing, "Dialog Plus" to make movie conversations easier to distinguish, and bass boosting, all under the collective banner of "SBX Pro Studio." But audiophiles usually look down their noses at most of these, accusing them of distorting the dynamic range of incoming sound. And you can disable SBX entirely if you don't care for it.

The metal knob on the front of the X7 controls volume, and pressing it mutes all audio. Unfortunately, we don't get an input selector, nor does the X7 save profiles for different devices or scenarios. When you have audio from multiple sources, it will blend together. The X7 also lacks HDMI, so its use as a home theater receiver is

limited to lossy 5.1 surround sound. And although it's external, its dimensions and AC power brick disqualify it as a practical portable audio device. While the X7 is undoubtedly a premium piece of hardware, its equally premium price puts it up against devices that have better connectivity to appeal to audiophiles. Gamers who want external and portable audio can find options — in some cases from Sound Blaster itself — at a fraction of the price.

■ Tom McNamara

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Plenty of top-shelf components and lots of connections, but it's a bit pricey and unwieldy.





\$175 | WWW.CORSAIR.COM

Corsair Hydro H110i GT

Effective and quick liquid cooling.

Although Corsair's H110i GT is in the 280mm radiator class (with two 140mm SP140L high static pressure fans), the whole assembly is somewhat larger at 322mm long – so this isn't a cooler for the more compact case.

Installation is a doddle. Four standoffs are screwed into the backplate, the pump mount bracket is placed over the pump, and then the whole unit is fixed in place by four thumbscrews. We had a bit of a shock when the standoffs were screwed into the backplate. You'll need to make sure you have a spare SATA power connector for power. A USB cable also plugs into the pump and into a USB header on your motherboard – this is for the Corsair Link utility, a very useful tool which allows you to control how the H110i GT works to a very fine degree. The speed of the pump can be altered, as can the two cooling fans (even to using a custom curve).

At our i7-4770K's stock

clock the fans ran pretty quiet, however, loading an overclocked CPU to 100% got the fans spinning at around 1,200rpm, and noticeably louder and struggling to keep the chip below 90°.

Changing to Performance mode in Corsair Link saw them running at an average of 1,800rpm and becoming louder again, but vitally dropping the CPU core temp down below 90°.

The Hydro H110i GT's ease of installing should calm the nerves of anybody new to the dark art of liquid cooling, and by using Corsair Link it can be tuned perfectly for any system, which is handy, as the fans are noisy when they're set to run at a high rpm.

■ Simon Crisp

Verdict

Easy to install; quick to cool; impressive software; noisy at full tilt.



\$189 | WWW.FRAC TAL-DESIGN.COM

Fractal Design Kelvin S24

Gotta love an expandable waistline.

Fractal Design's well known for its range of PC cases, but now it's got a range of AIO liquid CPU coolers too. The dual-fanned Kelvin S24 is the middle cooler in the range, sitting between the 120mm T12 and the 360mm S36.

Although the entire Kelvin set comes as all-in-one kits, they're really more like hybrids between an AIO and a DIY design. They've been created to be expandable, so it's possible to add another CPU block or a GPU block if so desired.

The S24 has been ambitiously designed to handle up to two CPUs and one or two GPUs. Both the cooler block and radiator are made from pure copper. Keeping everything cool is a pair of Fractal's own Silent Series 120mm fans which are PWM controlled with a decent spin range of 800 to 1,700rpm.

Fitting the S24 is straightforward. The pump fixes to the backplate via four thumbscrews which

use springs to prevent over-tightening. The longest job is screwing in the eight Hex screws which fix the two fans to the radiator.

The S24 kept our i7-4770K at just 17°C while idling with no real noticeable noise. However, loading the overclocked CPU to max meant the fans became very noticeable, while the temperature was kept at a toasty 76°C.

The S24 took far longer than the H110i GT to get the chip cooled down when returning to idle, however. So while this is a neat, simple, expandable AIO cooler, it's a tough one to recommend for overclockers.

■ Simon Crisp

Verdict

Easy install; decent performer; expandable.





GAMING MOUSE

£89 | WWW.CORSAIR.COM

Corsair M65 RGB

I can shoot a rainbow, shoot a rainbow, shoot a rainbow toooo.

Corsair's M65 RGB packs customisable LEDs that claims to be able to display 16.8 million colours. You can literally make sunshine blaze out of the mouse's backside and on to your desk and a beam also issues from the front of the mouse, as the wheel illumination leaks out.

Once you've finished customising, what are you left with though? You get an 8,200dpi infrared laser diode on the bottom of an aluminium unibody that apparently lowers weight and increases rigidity. It's lighter than it looks and you can tune weight distribution via three zones on the bottom and a screwdriver.

In the hand, the body of the mouse feels broad and low, with a satisfyingly large contact patch below the palm. The edges of the body panels aren't too protrusive, and it's generally a comfortable mouse to use once you've got used to how low it sits.

The M65 has a smooth

black coating on its upper surfaces that feels rather luxurious.

The main buttons, rated for 20 million clicks, feel responsive, while the sniper key that reduces sensitivity so you can pull off smooth headshots falls perfectly under the thumb. The two buttons above it are less perfectly placed, however, being just a little too indistinct from one another for our tastes. The mouse's greatest component must be its absolute beauty of a wheel: broad and grippy, with absolutely no chance of spinning it too far.

There's a good mouse here under the absurd lighting claims. You could easily use it all day without getting hand-fatigue.

■ Ian Evenden

Verdict

Looks great, feels great, moves great; it's got a wheel to die for, if that's not going too far.



GAMING MOUSE

£189 | WWW.ROCCAT.ORG

Roccat Tyon

That's Tyon, not Tyrion, Thrones' fans.

An MMO mouse, the Tyon is lighter and cheaper-feeling than others we've tested with a somewhat bulky presence. But it does have some interesting design ideas that we haven't seen before.

The buttons are not clustered around the thumb as they are on other MMO mice – instead, it has additional switches at the sides of the main left and right buttons. These stand tall over the flat main buttons, but have sloped tops so they can be pressed with a slide of the fingertip rather than having to lift your whole finger up.

While this is bad news for claw-grippers, as it doesn't fit into their handling structure at all well, palmers will have no problems, and the fin button on the centre-line of the mouse's back, designed to be pressed to either side by the knuckles of the index and middle fingers, makes it even clearer that this was designed with their kind of

grip in mind.

The Tyon's oddest, most intriguing feature has to be the analogue switch that's operated with the thumb. It's a tiny joystick that only moves in two directions, and springs back to the centre when released. Potential uses include controlling the speed and direction of turret rotation, and it's got enough resistance that it can be held precisely where it's needed.

Those who like the Tyon's idiosyncratic layout will no doubt love it, and there are certainly some sensational ideas to play around with. But it'll likely take a long period of time to get used to, so prospective buyers' should be prepared.

■ Dave James

Verdict

Plenty of thought has gone into this mouse, although it's hard to master.





ANDROID ACCESSORY

\$59 | WWW.DLINK.COM.AU

D-Link DSM-T100

A digital TV tuner for your Android smartphone or tablet.

For all the wonders our smartphones and tablets can perform, one thing they can't do is free to air TV. D-Link's new Portable Digital TV Receiver is aiming to change that – at least for Android users.

This tiny, thumbprint-sized device has a micro-USB plug on one end and a 25cm detachable loop of cable on the other, which acts as the device's antenna. (You can also optionally buy an adapter plug to use a regular TV antenna cable.) Setup is as easy as they come. Plug the dongle into an Android 4.0+ device, download and fire up the D-Link TV app, then perform a channel scan and you'll be able to watch any channels (standard and high-def) that are found. The app interface is quite good too, with a master channel list (including channel logos), EPG and the ability to adjust aspect ratio. You can even record shows, saving them to your phone's internal memory. (The one notable feature omission – there's no

closed captioning.) The DSM-T100 has some limitations however. With such a small antenna, we found the channels we could find varied wildly depending on location. And trying to watch TV on public transport proved fruitless: the varying signal strength means the picture is constantly breaking up or occasionally dropping out completely. There's also the matter of power draw. Watching 2 hours of TV at 50% brightness drained about 60% of our Galaxy Note 4's battery – far more than watching a locally-saved video or streaming from the web. Those shortcomings aside, the DSM-T100 does what it says it will, and does it quite well, for a reasonable price. ■ Dan Gardiner

Verdict

A serviceable way to get TV on your Android, with a few limitations to consider.



iOS STORAGE DEVICE

\$135 | WWW.SANDISK.COM.AU

SanDisk iXpand 32GB

Need more iOS storage?

One of the bugbears of iOS devices is that, unlike Android, there's no option to add more storage. And while SanDisk's iXpand flash drive is a little different from slipping in a microSD card, it's a relatively convenient way to get files onto an iOS device, or back up your device's photos and videos.

The iXpand is fairly simple. There's a USB plug on one end for connecting to a PC, where it works just like any normal USB flash drive. For iOS, there's a fold-out Lightning connector, which works with a special SanDisk iXpand app to let you browse the contents of the drive. The app can open and read PDFs, Word and Excel files, as well as most common images and MP4 videos, and the option to open files in third-party apps means you can send them elsewhere if you want to do more. Be warned though, that iOS's 'Open in...' command only works with a single file at a time, meaning if you're looking to import a

large amount of files into a third-party app (like whole seasons of TV shows into VLC, for example) you're in for a laborious process. The app also has an Automatic Camera Sync feature, which will copy any new pictures across to the drive when plugged in. On the downside, the drive's not particularly quick, with fairly paltry read and write speeds of 12.3 and 13.2MB/s – well under the 30MB/s cap of USB 2.0 (the top speed on the latest iOS devices). It takes about 90 seconds to copy 1GB. And the drive can only be formatted as FAT32, meaning there's a hard file-size limit of 4GB. So if you're looking at the iXpand as a quick way to get your 5GB+ high-def movies to an iPad or iPhone, you're out of luck. ■ Dan Gardiner

Verdict

Does the job for getting files onto iOS devices and backing up your snaps and vids, but is a little slow.

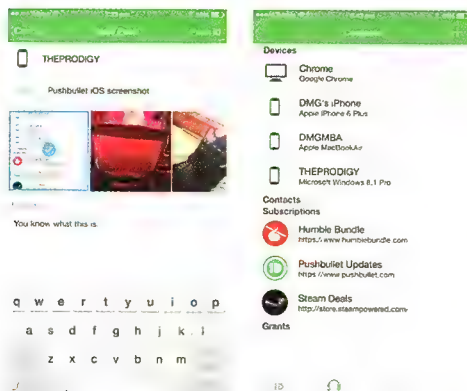
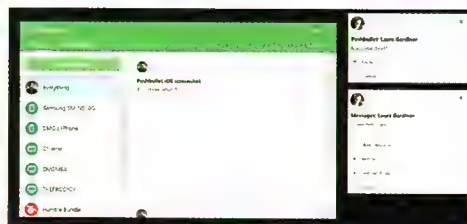
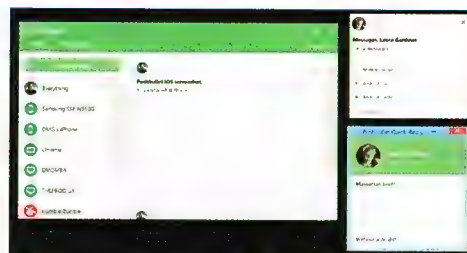
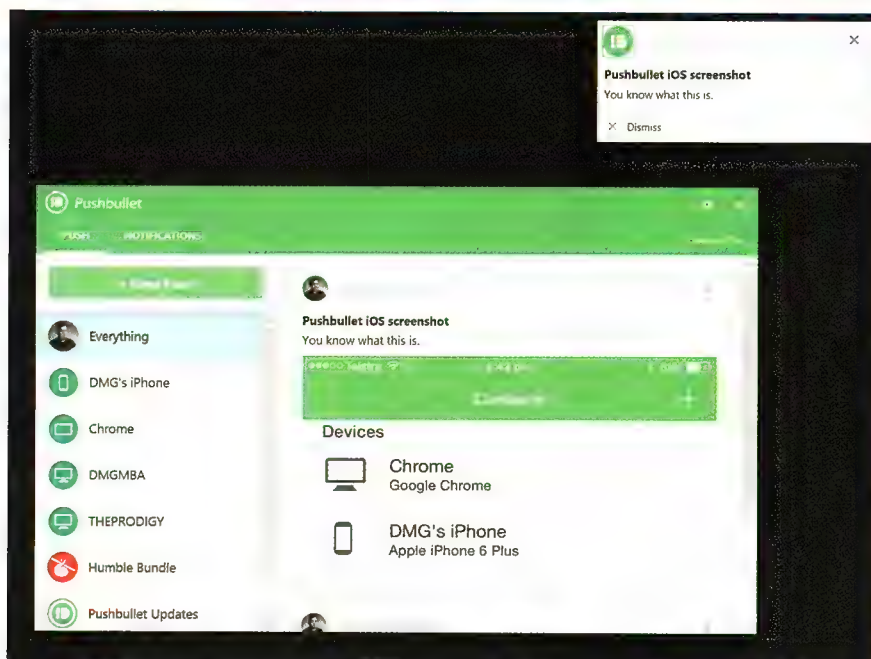


software

» APPS FOR ALL THE PLATFORMS



Windows SOFTWARE



Pushbullet

Struggling with a workflow that involves multiple devices? Pushbullet is the answer.

FREE | PUSHBULLET | WWW.PUSHBULLET.COM



Although it's a bit of a slippery product, conceptually, it's probably best to think of Pushbullet as a bucket. An online service which works via a bunch of apps and browser

extensions (making it available on almost every major platform), Pushbullet's main goal is to make working across multiple devices easier. It's built around a core messaging feature: the ability to send yourself quick snippets like text, links or images from one of your computing devices to another. So essentially, it's a bucket, into which you can throw things that you want to use on a different device. A quick example: you might take a photo on your phone that you want to quickly edit on your laptop. Rather than emailing it to yourself, just create a quick message and attach the image in Pushbullet. (The only limitation to sending files is a 25MB size limit and, on iOS, you can only sending photos or videos from your Camera Roll.)

While the same kind of messaging can arguably be achieved with email, the beauty of this approach is that you're not cluttering up your email inbox with small notes and other ephemera – you can have it all contained in one, dedicated place. On both desktop and mobiles, Pushbullet's interface is simple. Messages are presented as a single scrolling list, with new items popping in at the top, and messages stick around

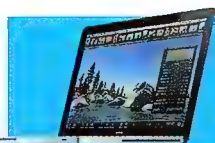
until you actively delete them. Setup is simply a matter of install the app on any devices you want to be able to use the service on – or on a desktop or laptop, using the browser extension for Chrome or Firefox.

If that were all Pushbullet could do, it perhaps wouldn't have gained the cult following it has. In addition to messaging though, Pushbullet has other nifty capabilities, like a universal copy and paste function (copy text on any device, then paste it on any other) or the ability to show app notifications from your phone on your PC.

Android users, in particular, can benefit from this and even directly to messages (such as SMSs and emails) from pop-up notifications on your PC, as well as see call notifications. That means you can safely throw your phone in your desk drawer when you get to work each morning and not worry about missing an important call or SMS. (This feature's sadly not available on iOS yet, likely due to Apple's tighter restrictions on third-party app access to those functions.)

It's hard to understate just how useful Pushbullet becomes when you start using it in earnest. It's the best kind of new app, in that it scratches an itch that you didn't even know needed attention – and does so smoothly and for free. If you're constantly working (or playing) across multiple digital devices, then Pushbullet is a must.

Dan Gardiner



Records

A no-nonsense name for a surprisingly friendly database creator.

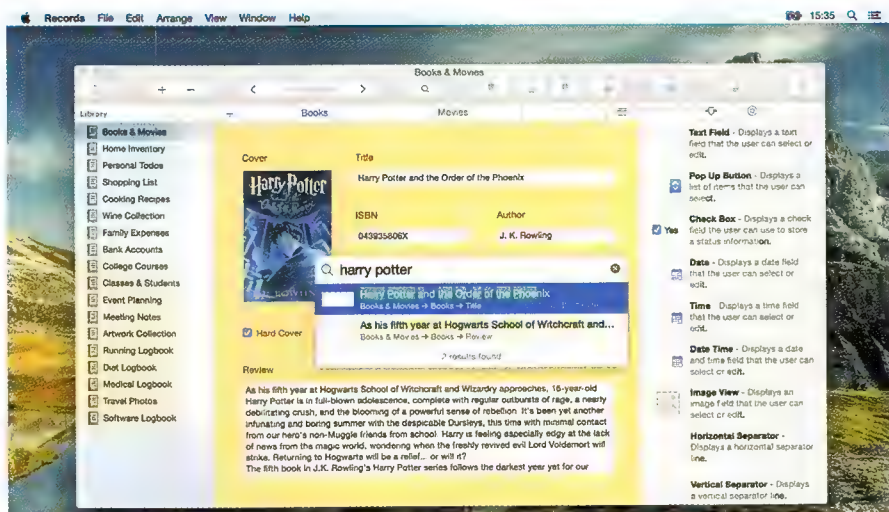
US\$49.99 | PUSH POPCORN
PUSHPOPCORN.COM



In late 2013, FileMaker put a stake through the heart of Bento, the company's personal database solution for OS X. The untimely demise of a longtime favourite left a sizeable void in the Applications folders of many Mac users, but a new contender has arrived on the Mac App Store to right this injustice.

Records is a surprisingly lightweight application (less than 10MB) that takes the drudgery and complexity out of creating personal databases, such as media collections, shopping lists, and other forms. Built for OS X Yosemite and optimised for Retina displays, Records takes full advantage of Apple's tech. From the clean WYSIWYG user interface, you can simply drag and drop any one of 14 ready-made form fields from the right-hand sidebar onto the main visual editor window at centre.

A virtually unlimited number of libraries can be created at left, each capable of storing tens of thousands of records across any number of forms,



which appear across the top as tabs. The built-in fields cover just about any kind of data imaginable (including pop-ups, checkboxes, and images), with editable headers to make them your own. Automatic alignment guides make layout a snap, but Records offers full manual control over each field, including text alignment and default value. Once added, objects can be copied and pasted for multiple entries, although a one-click duplicate feature (or duplicate X times) in the contextual menu would be a welcome addition for larger forms.

Records includes six colourful themes, but they apply across an entire library, rather than specific forms, which is a shame. There's also a list editor on hand, which can be used to create common data types that can be

frequently reused, such as Countries, Currency, and even Credit Cards. Once a library is complete, clicking the lock icon disables further editing, effectively turning libraries into read-only databases with rapid-fire text search.

Despite an impressive version 1.0, Records's biggest weakness is its inability to open or import databases created with other products, including those from the orphaned Bento. However, the developer has laid the groundwork for a vibrant template-sharing community to blossom over time. The bottom line? Records is an impressively nimble piece of Mac software that makes personal databases insanely simple to create and use.

J. R. Bookwalter

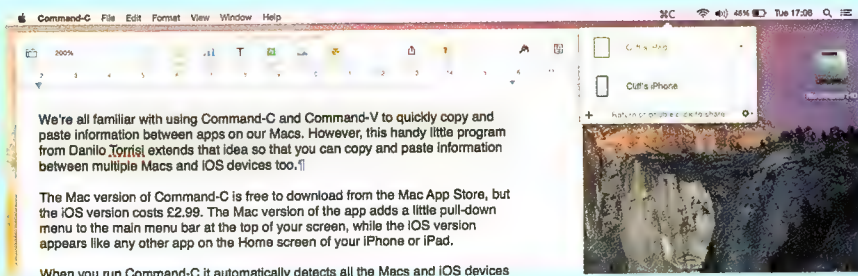
Command-C

MAC, FREE; IOS, \$4.99 | DANILO TORRISI | DANILO.TO



We're all familiar with using Command-C and Command-V shortcuts to copy and paste information. But this

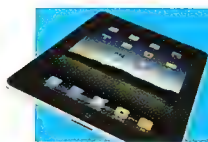
handy app extends that idea to work between multiple Apple devices. The Mac version adds an icon to the menu bar at the top of your screen, while the iOS version appears like any other app on the Home screen of your iPhone or iPad. When you run Command-C it automatically detects all the Macs and iOS devices on your Wi-Fi network, and you can then link them together simply by tapping



their name in the list. Any text you copy on one device can be transferred to any other device and then pasted into any app you want. Besides being useful for quickly copying information such as web links or people's addresses, Command-C allows you to transfer photos between devices as well. There are other nice touches too, such as the History option on the iOS app that

stores all the information transferred between devices, so you can go back and retrieve items from a few days ago. Admittedly, Command-C is something of a one-trick pony, but it's a handy time-saving trick that many people will find very useful. It's just a shame that it doesn't work with Windows too.

Cliff Joseph



App Store » iOS APPS

Do Camera

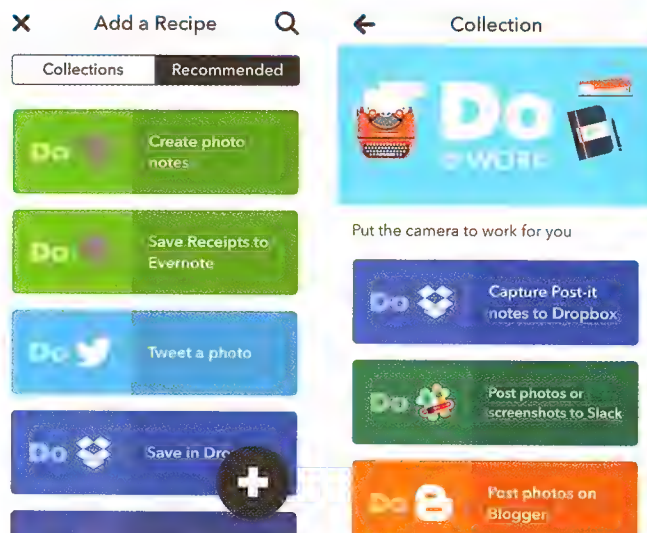
Make a camera app that does what you want.

FREE | IFTTT.COM

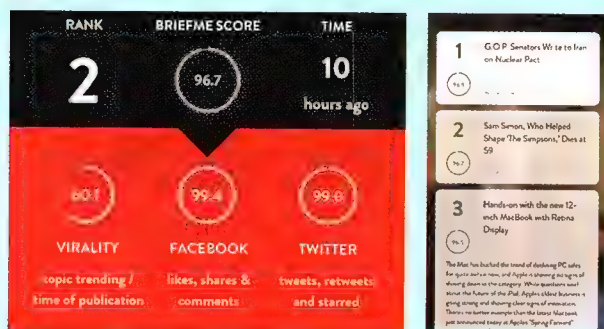


The devs at IFTTT ('If This Then That') already have a considerable following from their IF app on Android and iOS, which take the web service's powerful 'ties everything together' capabilities and make them accessible on your smartphone.

Surprisingly, the company's new Do apps (Button, Camera and Note) are even simpler. Do Camera, as the name suggests, is built around taking photos. The interface is streamlined, with space for only three 'actions' that, for example, automatically post to reddit when you take a photo. What emerges is a camera app that's tailored to the tasks you value most. Whether you want it to automatically email new photos to friends or upload shots directly to Dropbox and Evernote, the Do Camera makes creating a desired action easy. There's a comprehensive list of recommended actions to choose from and the app is surprisingly interconnected. But the simplicity of the Do Camera's tasks — compared with



the full IFTTT app — makes it feel too specific to be broadly useful. Still, we'd definitely suggest downloading this one and taking a look at the recipes — who knows, it may actually have the perfect recipe for you to Do.
Joel Burgess

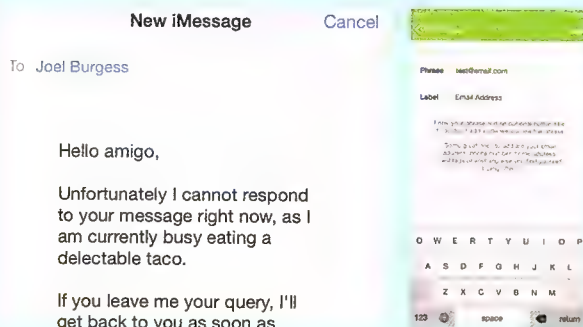


BriefMe

FREE | WWW.GETBRIEFME.COM



We've all heard the expression "the cream rises to the top", and it is one that the team behind the new app BriefMe has taken to heart, promising to give us "just the cream" when it comes to the most read and shared news from around the world. It's a whole new way of digesting the news you need to know each day. BriefMe gives you ranks the ten most important news stories of any given section per day, based on how many times it has been commented on, liked and shared on Facebook, tweeted, retweeted and starred on Twitter, and on its Virality (how trending the topic is). BriefMe applies a score for each of criteria, and an overall score for ranking purposes. The app is broken up into sections, including Politics, World, Business, Sports, Technology and Entertainment, as well as a Briefing section which rounds up the ten most biggest news stories overall. Or, you can opt to just follow a feed of constantly updating news stories in the Stream section.
Stephen Lambrechts



WordBoard Keyboard

FREE | WWW.BYTESIZEAPPS.NET



Ever get sick of having to type your full name, email addresses and other phrases over and over again on your smartphone? Introducing WordBoard Keyboard — an app that saves you typing time and effort. After enabling WordBoard in your keyboard settings, you can add your desired phrases into the WordBoard keyboard app, and then cycle through your keyboards when needed to use your saved phrases. The app is especially useful for its ability to let you drop a large email template or message with a single touch of a button. Also, you can save your own details in custom made keys and use them to fill out forms faster. The downside to using WordBoard Keyboard is that it replaces the iPhone's normal keyboard with its own version, featuring slightly smaller keys, a different font, and oddly placed function keys which instantly makes using it a discomfoting experience. WordBoard is an awesome concept, though its execution could do with some fine tuning.
Stephen Lambrechts



Google Play » ANDROID

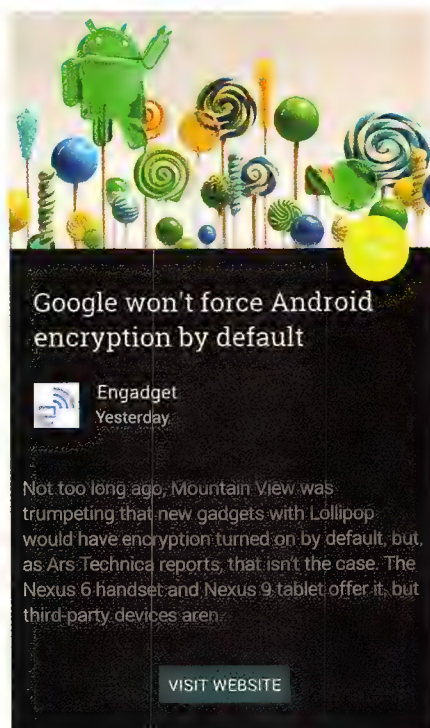
Palabre

One slick newsreader, but a little feature light.

FREE | LEVELUPSTUDIO | TINYURL.COM/APC414-A-RSS

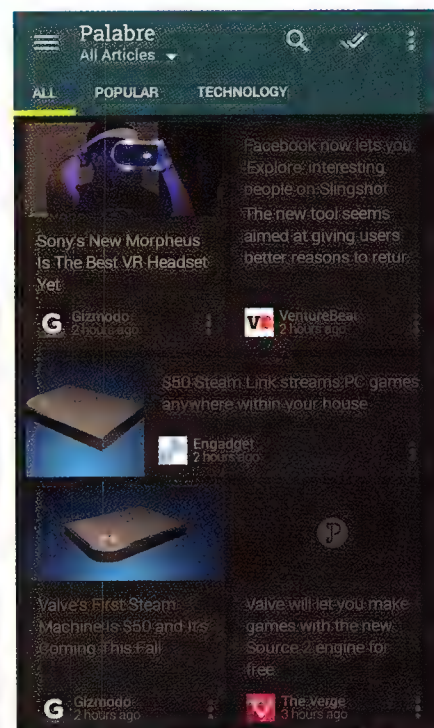
If you're using a recent HTC handset – almost all have a dedicated 'news feeds' widget as a home screen – additional RSS readers can be a little hard sell. Palabre is one app that you might want to make an exception for, however.

The interface design follows Google's new Material look, and you can either manually enter RSS feeds or sign-in and sync with a Feedly (www.feedly.com) account – with the latter obviously saving you a bunch of time transferring sources. It comes with all the basics you'd expect, like a built-in browser and can automatically mark articles as 'read' when you scroll through them. But Palabre is only just out of beta phase and so at present, it lacks elements like swipeable actions



and export features. While Palabre is free, it does have ads – and removing them will set you back €2 (about \$2.80).

If you already have a favourite RSS reader on Android, it probably isn't



worth making the switch to this one just yet, but what is here shows a lot of potential. One to keep an eye on, then. Joel Burgess

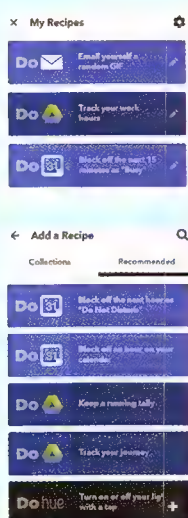
Do Button by IFTTT

FREE | IFTTT | IFTTT.COM



Part of a trio of 'Do' apps by IFTTT, Do Button lets you browse and create 'recipes' that make

complex, time-consuming tasks as simple as touching a single button. Do Button has a large range of recipes on offer, split into five categories: Do Essentials, Do @ Home, Do @ Work, Do @ Play and Do Families (that last one isn't as dirty as it sounds). Perfect for the modern, always-connected individual, you can use the button to set your Nest thermostat, control your air conditioning, control your Hue lights, post pictures to social media, message your friends, email yourself and much more. You can set three recipes to the app at a time, and the last one you use shows up as a large button on the app's home screen. You can switch and replace your three chosen recipes at will, though it would be nice to set more than three – ten would've been a more satisfying number. Do Button is available for both iOS and Android devices. Stephen Lambrechts



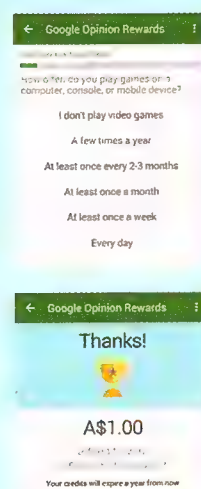
Google Opinion Rewards

FREE | GOOGLE | TINYURL.COM/APC414-GOR



As the name suggests, this app will give you rewards for your opinions. 'Rewards' being small

amounts of Play Store credit (from \$0.20 to \$1, in our experience) which can be used to purchase apps, games, movies/TV or ebooks. Giving your opinions entails answering short, in-app surveys. Most are multiple choice, although on occasion you will be asked to fill out a slightly more detailed one-liner response. A lot of the research conducted through Opinion Rewards seems to be for third parties, rather than Google. Questions often centre around brands and branding exercises, with questions like, 'Do you recognise such-and-such?' and 'What is the message in this slide?' Over a couple of months, we managed to rack up around \$10 worth of credit from casually doing surveys. Just be aware that taking these surveys could let Google build up quite a detailed marketing profile of you. Dan Gardiner





Windows Store » WIN PHONE 8

App Lock

Hide your more 'interesting' photos.

FREE | TAP PLEX | TINYURL.COM/APC414-ALOCK



If you're like us, chances are you have at least some photos or images on your smartphone that aren't appropriate for everyone to see. With App Lock, instead of being afraid of handing over your device — and seeming a little odd in the process — you can hide your sensitive images from view. App Lock is not the first app to develop a secure vault to store sensitive files, though it does offer the convenience of being able to integrate directly with the Windows Phone photos app. So instead of copying images into a folder and then deleting them from the Photos app, selecting images in App Locker hides them directly within the existing Photos folder. This is not only convenient, it also means that you're not copying these images into a new app that may store images or passwords elsewhere. You can also set up a swipe-pattern lock to save you having to learn an additional password. If you don't already have an application to conceal photos, App Lock is a good one to squirrel away somewhere on your phone. JB



Select all



Lock

...



DataBot

FREE | ANDREA TESTA
| DATABOT-APP.COM

Cortana hasn't been out that long, yet the Halo-inspired digital-assistant for Windows Phone already has some competition. DataBot is a free, slick-looking voice-activated hub of general information, alongside quotes, jokes and brain games. The app works on modules, each containing a set of voice commands. These can activate basic settings — like your flashlight — or even find and read aloud information about a public figure. There are nine modules that come with the initial DataBot download, but you can purchase upgrades to add features like an RSS reader or an entertainment info module; neatly, these can either be purchased (\$0.99-\$3.99), or earned for free based on experience points. There are a number of grammatical and pronunciation errors within the app's instructions and information modules, but the brain games are engaging and the speech recognition is good enough to be useful. Atmospheric mechanical noises that sound at the push of a button contribute to the overall aesthetic and make for an quirky but interesting app. This is one of the most polished Windows Phone exclusives we've seen. JB



MEGA
Privacy

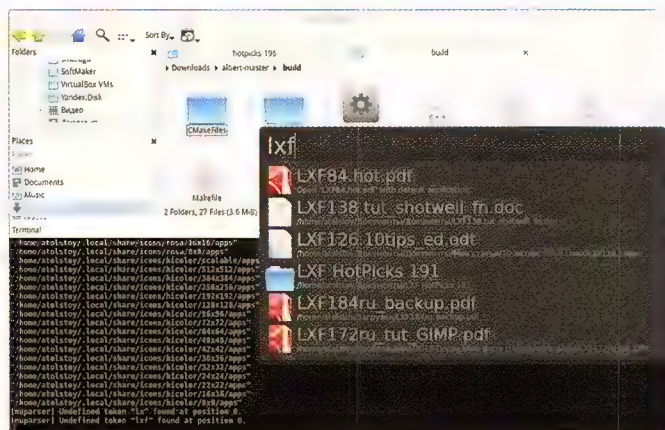
FREE | MEGA LIMITED |
MEGA.CO.NZ

Mega is a New Zealand cloud-services company started in 2013 by the infamous hacker and internet entrepreneur Kim Dotcom. Mega was created to be a secure replacement for Dotcom's former site, MegaUpload, which was seized by the US government over accusations of copyright infringement in 2012. Now with a decent following, the encrypted cloud platform has finally officially arrived on Windows Phone. Mega Privacy is an online storage service that encrypts every bit of data stored. It does so using a personal master password, with no recovery options — so it's absolutely critical you don't forget it. The free service offers a decent 50GB of storage space, and its main point of difference from other cloud-storage services is that you, as the user, have complete control over the encryption keys. Not even Mega itself can access your encrypted data. Mega Privacy is no more difficult to use than Dropbox, but offers an extra layer of security. If you are concerned about storing documents safely online, then Mega Privacy offers better security than most. Joel Burgess





Linux SOFTWARE



Albert

A Linux desktop launcher that apes the Apple experience.

FREE | MANUEL SCHNEIDER | [BIT.LY/ALBERTLAUNCHER](http://bit.ly/albertlauncher)

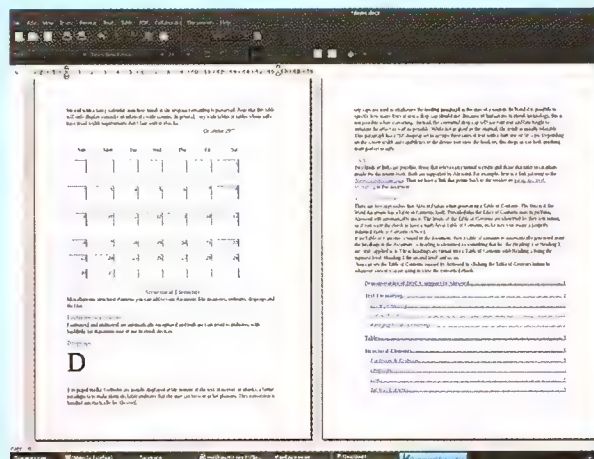


Apple introduced Spotlight over 11 years ago, an amazing system-wide desktop search feature, which has inspired many similar open source technologies. For instance, you might have heard of Beagle, which stopped development in 2009, or some more recent and active projects, such as Unity's search lens and Synapse. Albert is another application, which is something in between a launcher and a global search tool. It's a fast, Qt5-powered and desktop environment agnostic omni launcher (it's name is a play on the Alfred launcher in OS X).

Albert can run applications, open files, open Chromium bookmarks, calculate math expressions, search the internet and more if you enable optional modules. Firefox bookmarks aren't indexed right now, but its support is planned for the nearest future. Ubuntu users can get it from ppa:nilarimogard/webupd8, other users will likely have to build it from source (you'll need the Qt5-dev stack and cmake if that's the case).

The first time you run Albert, you'll be greeted with its Settings window. The first thing we advise doing is to assign a hotkey for invoking the Albert search bar. Under the General tab you can also edit the history depth; the number of proposals; and the search bar look, position and extra action modifiers. If you add more folders to Albert's index, please keep tracking the memory usage as while the default Albert configuration needs 10MB of RAM, adding a folder with a massive set of files can push memory usage to hundreds of megabytes.

The Modules tab currently has five modules, for web search, calculator, app index, bookmark index and file index. Each (aside from the calculator) is configurable: For example, you can add or remove search paths or define a path to browser bookmarks file. Another big feature is fuzzy search, which has to be enabled manually for the app index module. Albert is under heavy development, and its search backend is constantly evolving, so it's likely that by the time you read this its capabilities will be even more advanced.



AbiWord

FREE | [ABISOURCE.COMMUNITY](http://abisource.com) | [ABIWORD.ORG](http://abiword.org)



AbiWord's new version number — 3.0.1 — may seem to indicate a minor update over 3.0.0, but the developers haven't been idle for the past year and a half since rolling out that major release. And, again, the team is offering something special for those who are involved in lots of typing and formatting of documents.

The most praised and highly anticipated feature of AbiWord 3.0.1 is the default OpenXML plugin, which has better support for the DOCX file format. There has been DOCX support in a few previous AbiWord releases, but it was optional and many packages (such as for Gentoo or FreeBSD) disabled the OpenXML plug-in because it wasn't considered stable enough. Now the problems are mostly solved and, when you have to, you can now open Microsoft Word documents directly, modify them and save, and write any changes to the original file.

After rolling out the 3.0.0, the AbiWord developers faced many stability and performance issues that were introduced along with their much-praised transition to the GTK3 toolkit. In 3.0.1 most of those issues are solved. For instance, AbiWord no longer crashes while importing complex documents and redrawing some areas; and it also no longer has GTK memory leaks and is generally more stable.

AbiWord remains a feature-rich, yet lightweight competitor of LibreOffice Writer, and it offers gorgeous collaboration features, including Telepathy support, along with support for the Resource Description Framework (RDF), the original grammar-checking parser (known as Link Grammar) and some handy optional plugins. We were pleased to be able to work with correctly formatted LaTeX formulas and had fun with Open Text Summarizer (libots), which automatically extracts the plot from voluminous texts.

AbiWord can be found in almost any Linux distro, but we can't guarantee that the software will be updated everywhere to the latest version, but you can compile the application from source. This way also brings more freedom, because you can decide, which features you want to enable or disable, according to your preferences.

SUPER CHARGED NETWORK

YOU WANT IT FAST AND YOU WANT IT RELIABLE. IF YOU'RE LOOKING TO BUILD THE BEST HOME NETWORK YOU CAN, YOU'LL PROBABLY HAVE TO DO A LITTLE RESEARCH - AND PERHAPS BE WILLING TO PERFORM A LITTLE HANDY WORK. NATHAN TAYLOR REVEALS HOW TO GET STARTED.



STATE OF THE WIRED

BEST IN SLOT: 10-GIGABIT ETHERNET (OR GIGABIT ETHERNET IF YOU HAPPEN TO BE NOT RICH)

It's something we've said repeatedly — when it comes to speeds, wireless will never beat wired, despite what the specs say. Yes, 1000Mbps Ethernet is better than 1733Mbps wireless, because Ethernet comes much closer to reaching its theoretical speeds. In practice, you'll get a 600-800Mbps out of Gigabit Ethernet at any range, while that's really best-case for wireless. What's more, it's absolutely reliable.

Given that, it's absolutely worth

wiring up fixed-position devices in your home, like desktop PCs, game consoles, network attached storage and networked media players. Ethernet cables are quite hardy, and you can typically have cable lengths of up to 100m without seeing a huge degradation in performance. Thanks to their plastic sheath, they can also be run outdoors as long as the connectors are not exposed to water (although we would recommend specially-made outdoor Ethernet cables for extra durability).

The cleanest scenario is to have the cables run through the walls, with neat wall plates in each room for connecting the devices. This takes some planning and perhaps the help of someone handy, however. If you plan on going this route, expect to spend a day or two on it and be

prepared for some crawling through cobweb-infested cavities.

More commonly, people tend to run just one or two Ethernet cables to major device hubs (like the lounge room or study), drilling holes in the floor or ceiling to run a pre-made cable back to the switch. It's a little uglier than the wall duct solution, but generally easy enough to hide.

Remember that Ethernet is very flexible, with the possibility of daisy chaining switches. If you have four devices in your lounge room you'd like to connect, you still only need to run a single Ethernet cable and connect it to an Ethernet switch in the lounge room, which can in turn be used to connect the individual devices. Yes it's technically not as speedy as four separate cables (since the four devices are sharing the

The Netgear XS708E 8-port 10GbE switch, about the cheapest 10GbE switch we could find (and still around \$1000).



single “backbone” line), but in practice your devices aren’t going to be competing too much for bandwidth.

If Ethernet is not an option, you can also use powerline networking, also known as HomePlug. HomePlug AV2 powerline products are as cheap as they have ever been, and are currently available at speeds of up to 600Mbps. You simply plug them into mains power points in your home and they create a link using your power lines as the transmission media. They tend to provide very consistent, low latency speeds. They are nearly always better than wireless at a similar range – although it’s best not to plug them into powerboards.

SWITCH SPEED

Talking “ultimate” with wired is a little tricky right. On a purely theoretical level, the best you can get right now is 10-Gigabit Ethernet (10GbE) over CAT 6A cabling. That’s a setup that’s likely to set you back thousands of dollars right now, however. The cheapest 10GbE switch we’ve seen is an 8-port Netgear device that costs over \$1,000 (compared to about \$50 for a Gigabit switch). If you want a NAS with 10GbE as well as PC cards with it, expect to be forking out even more.

More commonly you’ll be getting Gigabit Ethernet, which has thankfully (finally) become standard in most

“More commonly, people tend to run just one or two Ethernet cables to major device hubs.”

new home routers. If a router or switch still has Fast (100Mbps) Ethernet, don’t buy it.

WHAT’S COMING?

When it comes to Ethernet, it looks like Gigabit is what we’ll be stuck with for some time. 10GbE has been around for a long time, but has made few inroads into the consumer space. Heck, there’s already 40GbE and 100GbE standards – although those require either optical fibre or new Cat 8 cabling.

Much more exciting stuff is happening with powerline networking. Although 500Mbps and 600Mbps HomePlug devices are the standard right now, we’re starting to see 1000, 1200, 1800Mbps and 2000Mbps MIMO devices be announced. In 2013 and 2014 we saw the launch of major new multi-stream chips from the major HomePlug providers, and just this year we’re starting to see the fruits of that, with HomePlug devices that can rival gigabit Ethernet for speed.

STATE OF THE WIRELESS

BEST IN SLOT: WIRELESS AC2350 WITH BEAMFORMING

Before we get into what you should be looking for, we should talk about how wireless speeds work. Three factors affect base speed: modulation, channel size and MIMO streams. Modulation – how digital information is represented on the airwaves – was improved in 802.11ac. It typically gets about 108Gbps per 20MHz of channel bandwidth; 802.11n gets 72 to 75Mbps. The older 802.11n standard was also limited to 40MHz channels (for

So much neater than having a bunch of Ethernet cables running across your floors.



The just announced D-Link DHP-701AV AV2 2000 powerline adapter, supporting 2Gbps.

Cable quality

There isn’t just “Ethernet” cable and that’s it: Ethernet cable comes in a variety of qualities, called Categories.

The cable you buy will typically be one of four: Cat 5, Cat 5e, Cat 6 and Cat 6a. As you can imagine, Cat 6a is the best, capable of carrying 10-Gigabit Ethernet to 100m with minimum interference. Cat 6 can carry 10-Gigabit Ethernet to 55m (or 33m if cables are bundled).

Cat 5 and 5e cannot support 10-Gigabit Ethernet, and Cat 5 can struggle with Gigabit Ethernet, though Cat 5e can handle it without problems.

Technically, given that most of our current equipment is limited to Gigabit, Cat 5e cable is good enough for most home wiring. If you’re going to the trouble of stringing cable through wall ducts, however, you might want to think about paying that little extra (and the extra cost is quite minimal) for Cat 6a to future proof your home.

Wireless AC ratings

Most routers are advertised with an “AC” rating, usually a composite number combining the 2.4GHz 802.11n speed with the 5GHz 802.11ac rating.

It’s a little deceptive, since a given device can only speak on one network at a time, so the top speed on a AC1750 is actually 1300Mbps, for example. It’s also messy, since some router vendors actually do separate the ac and n speeds; so for example might list the device as 1300AC/900N.

In general, however, there appears to be a consensus of sorts. Here’s the breakdown of how the speeds actually shake out in various router ratings:

	802.11N SPEED	802.11AC SPEED
AC600	150	433
AC750	300	433
AC1200	300	867
AC1300	400*	867
AC1450	450	975
AC1600	300	1300
AC1750	450	1300
AC1900	600*	1300
AC2350	600	1733
AC3200	600	2600 (1300 X 2)*

“Looking at what’s available now, the best you can get is a four-antenna 802.11ac device.”

150Mbps); 802.11ac can go to 160MHz, though 80MHz is most common (for 433Mbps).

Finally we have MIMO, multiple input and multiple output. MIMO uses extra antennas to create additional spatially differentiated streams in the same channel, each stream carrying as much data as the original. You can often tell how many MIMO streams are supported by the number of antennas a router has. 802.11n supports four MIMO streams (total 600Mbps). 802.11ac can theoretically have eight, but the most we’ve seen is four (for a total of 1733Mbps). In theory, 802.11ac with 160MHz channels and eight MIMO streams can hit 6936Mbps.

Looking at what’s available now, the best you can get is a four-antenna 802.11ac device, which should be marked with the “AC2350” moniker. As with other “AC” ratings, it comes from combining the speed of the 2.4GHz 802.11n network (600Mbps) with the speed of the 5GHz 802.11ac network (1733Mbps, rounded up to 1750).

Is that worth getting for you, however? There’s a pretty big price premium on 4X4 MIMO devices like

this, and as you may be aware, both the wireless device and the access point have to support the full spec to be able to hit top speeds. Heck, only new high-end mobiles support 802.11ac at all, and those that do would be lucky to support 2X2 MIMO. We’ve not seen a mobile device that supports three MIMO streams let alone four. If your mobile only supports two MIMO streams, for example, you can’t get better than 867Mbps no matter how good the router is.

There is still value in three (1300Mbps) and four (1733Mbps) stream routers, however, even if your mobile devices don’t actually support it. 802.11ac has the capacity to designate MIMO streams to devices through multi-user MIMO. For example, if the router can transmit four streams, and you have two mobiles that each support two-stream MIMO, then they can both (theoretically) hit their top speed simultaneously because of the way the MIMO streams can be shared between them.

Newer routers also come with a feature called beamforming, which is recommended. Beamforming uses a



The ASUS RT-AC87U AC2350 router. Note the four antennae.

complex system constructive and destructive interference from multiple antennae to steer a signal at a particular device rather than simply transmitting it omnidirectionally (which is what Wi-Fi routers normally do). The effect is that more of the transmission power is directed at the target rather than sent off pointlessly away from the intended target. The outcome is a stronger signal, particularly at medium range. According to most reports, you can expect a 2-5dBm stronger signal at medium range with beamforming. It’s not earth shattering, but it can make enough of a difference to bump you up to the next wireless speed bracket.

As noted by the asterisks, there are some odd caveats here. AC1300 and AC1900 use a non-standard form of 802.11n to bump speeds up to 200Mbps per antenna. Essentially they take the modulation tech of 802.11ac and apply it to 802.11n – but a lot of client devices won’t support that and will behave as if they were 300 (AC1200) or 450Mbps (AC1750) devices.

AC3200 is being used by a couple of new devices like the Netgear Nighthawk X6 and ASUS RT-AC3200. These devices have six antennae and create two discrete 802.11ac networks, each with their own SSID. A given device can only communicate on one of them, however, so the per-device speed is limited to 1300Mbps. Netgear and ASUS are calling these “tri-band” devices, but they shouldn’t be confused with devices that support 60GHz 802.11ad.

WHAT’S COMING?

In terms of Wi-Fi, 802.11ac is going to be with us for good time to come. If you’re thinking “but I want to hold out for the next big thing,” then you’ll be holding out for quite some time. The successor to 802.11ac is not expected until 2019 at the earliest (though draft products may come out sooner).

It is in the works, however. Development of 802.11ax, the expected successor to 802.11ac, is well underway, with a goal of quadrupling speeds to individual clients on the network. Speeds of up to 10.53Gbps have already been reported by the working group thanks to a new encoding scheme and underlying improvements to interference management and client communications.



The upcoming RT-AC3200. It looks kind of evil.



Until WiGig comes into its own (if it ever does), we'll be relying on devices like the Chromecast and Miracast for wireless display streaming. They use plain old Wi-Fi.

In the nearer future we might see so-called tri-band designs appear, using the already ratified 802.11ad spec, AKA WiGig. Now there's a pretty good chance you've probably never heard of the 802.11ad standard, in spite of it being published back in 2009. It hasn't yet made any kind of noticeable market impact. In theory, however, it could be good for very short range peripheral connectivity, allowing Miracast/Google Cast/AirPlay style wireless display connectivity in full HD and even 4K. WiGig uses the 60GHz radio band, which has serious trouble penetrating any kind of obstacle but can transmit data at very high rates – up to 7Gbps at short range. It's designed, essentially, to provide same-room connectivity between devices at very high speeds.

There have been a few tri-band (2.4GHz, 5GHz, 60GHz) chips announced, but we've yet seen no products in the consumer space. There is hope for the standard, however: many of the developers of competing standards, including Wireless USB, are slowly seeming to start to rally around it. A WiGig Certified campaign is due to start next year for new WiGig devices.

(We should note here that 802.11ad tri-band has no relation to the new "AC3200" tri-band devices from Netgear and ASUS – those devices create multiple networks in the 5GHz space, not 60GHz networks).

RANGE EXTENSION

BEST IN SLOT: AN ADDITIONAL ROUTER/ACCESS POINT BRIDGED WITH GIGABIT ETHERNET

We'll come right out and say it: we're not big fans of range extenders. Yep, we get why they exist, and why they might be useful in some instances. But as performance devices, they kinda blow. They tend to add massive latency to wireless connections, making gaming and voice chat horrible. They can also halve your bandwidth, since the extender has to both send and receive the data on the same channel.

If you must go with a range extender, look for one that supports 802.11ac and/or crossband. Crossband uses one band (2.4GHz or 5GHz) to connect back to the source network and the other to extend the range – thus solving the half-bandwidth problem. (Netgear, it should be noted, calls this FastLane Technology rather than crossband).

A better solution than a range extender, if it's available, is to set up an additional wireless access point or router, and link it back to the original using an Ethernet cable. It won't compete for radio space with the

original, and you get full speed with minimal latency. In lieu of an Ethernet cable, you can also use powerline networking to bridge the primary and secondary wireless networks.

ROUTER FIRMWARE & FEATURES

BEST IN SLOT: DD-WRT, OPENWRT OR TOMATO.

If you're especially keen on building the most advanced network you can, we also recommend playing with open firmwares like DD-WRT (www.dd-wrt.com), OpenWRT (openwrt.org) and Tomato (www.polarcloud.com/tomato). These router firmwares replace the official router firmware from the router vendor, and are almost always superior. Indeed several vendors, notably ASUS and Linksys (which originally created the open source WRT firmware, then abandoned it, and has now returned) have begun using them in lieu of their proprietary solutions.

Of particular note is the integral support for VPNs in the open firmwares – either client or server. Given how important VPNs are becoming to privacy and anonymity, being able to connect to one at the router level, thus providing protection to all the devices on your network, is invaluable. Very few proprietary consumer router firmwares provide VPN support.

There's a lot of other stuff to like here as well. Network diagnostics, hotspot and guest support, USB server and 3G failover support, per-IP traffic stats and management, wireless power tweaking and quite a bit more is possible with open firmware.

DD-WRT is our current favourite – but yes, it's complicated, and you might have to do some research to set it up and understand its options.

The screenshot shows the DD-WRT control panel interface. At the top, there's a status bar with 'Firmware: DD-WRT v24-sp2 (02/22/15) std' and 'Time: 00:50:08 up 9 min, load average: 0.48, 0.47, 0.25'. Below this is a navigation menu with tabs for Setup, Wireless, Services, Security, Access Restrictions, NAT / QoS, Administration, and Status. The 'Status' tab is selected, showing a sub-menu with Router, WAN, LAN, Wireless, Bandwidth, and Sys-Info. The 'Router Information' section is expanded, displaying the following details:

Router Information	
System	
Router Name	DD-WRT
Router Model	Asus RT-AC3200
Firmware Version	DD-WRT v24-sp2 (02/22/15) std - build 26332
Kernel Version	Linux 3.10.69 #3661 SMP Sun Feb 22 06:27:02 CET 2015 armv7l
MAC Address	
Hostname	DD-WRT
WAN Domain Name	
LAN Domain Name	dd-wrt
Current Time	Mon, 23 Feb 2015 00:50:08
Uptime	9 min

On the right side of the 'Router Information' section, there are several informational blocks:

- Help:** more...
- Router Name:** This is the specific name for the router, which you set on the Setup tab.
- MAC Address:** This is the router's MAC Address, as seen by your ISP.
- Firmware Version:** This is the router's current firmware.
- Current Time:** This is time received from the ntp server set on the Setup / Basic Setup tab.
- Uptime:** This is a measure of the time the router has been "up" and running.

Networking supertest

Want to create the best hardware setup for your home network? **Nathan Taylor** rounds up the top routers and accessories available today.

If you're still languishing on a network that struggles to stream Full HD movies – let alone 4K streams – it might be time to think about upgrading your hardware. New router and range extenders are pushing wireless further than it has ever gotten, with some devices even legitimately capable of rivalling Gigabit Ethernet wired connection for performance if not reliability.

We're also finding that router vendors are getting better at implementing the stuff that doesn't always make it to the specification sheets. Antenna design and signal amplifiers are much better than they were just a few years ago, so you'll get better reception than on your older devices.

Firmware has also improved, with better mobile configuration support, remote storage access, parental controls and even VPN support becoming serious capabilities on

newer devices. For these capabilities alone, it's worth investigating an upgrade.

Below we've looked at three categories of devices. First up are ADSL modem routers, which are for ADSL users (although many of them can also serve as a general broadband router). Next is broadband routers – that is, devices without an inbuilt modem. If you're lucky enough to have NBN fibre or have an existing modem and just want the new wireless capabilities, these are your go to. Finally there are range extenders, for when your wireless signal doesn't quite reach all the corners of your house.

HOW WE TESTED

To get an impression of how the wireless devices will work in a common home scenario, we tried using each wireless device at a range of 15m with two intervening plaster walls. We connected to the devices with both a Samsung Galaxy S5 mobile and a

laptop connected to a Linksys WUMC710 bridge.

We used an app called WiFi Analyzer on the mobile to get a signal power reading for each device to see how well the signal was holding up at that range. Signal power is measured in dBm relative to a 1 mW reference signal, and the number on Wi-Fi networks is always a negative. The lower the number (remembering that it's a negative), the worse the signal, so -90dBm is worse than -60dBm.

We also performed file copy tests using the laptop, of a 1GB file streamed over the wireless network.

What we haven't done here is put the test results in a table, since when it comes to wireless the results are hardly definitive. There are a million variables affecting wireless performance, and you might get quite different results in your home. Still, where the results we received are notable we've talked about them in the individual reviews.

LINKSYS WUMC710

Want your older devices on AC too?

Although it's now a relatively old product, the Linksys WUMC710 remains our favourite wireless AC bridge, perfect for bringing AC to your older lounge room devices that might yet be languishing on 802.11n. It's very simple: you set it up as a client to your AC network, then any wired devices you plug into one of its four gigabit Ethernet ports will also be connected to that network.

More than anything, it's the WUMC710's performance that sells us on it. There's a reason we use it for a lot of our testing – it remains the fastest 802.11ac client device we've seen by a considerable margin. It supports full 1300Mbps and has consistently offered higher throughput (by far) than any USB adapter or internal WiFi chip, most of which can only hit 867Mbps.

It remains a little on the expensive side for a device that only does the one thing, but if you want maximum performance for your older fixed location devices, it's hard to beat.

\$130 | WWW.LINKSYS.COM

Wireless AC 1300Mbps; four Gigabit Ethernet ports.



Verdict

The best Wi-Fi to Ethernet bridge we've seen.





ADSL MODEM ROUTER

\$290 | WWW.ASUS.COM.AU

Wireless AC1900: 1300Mbps AC, 600Mbps N (using 3x3 MIMO) with beamforming; Wired LAN: 4 gigabit ports, one ADSL/VDSL port; 1 USB 3.0 port.

ASUS DSL-AC68U

Open firmware.

ASUS have put a consumer-friendly sheen on this, with easy setup, security audits and online guides, but if you drill down its feature set is unrivalled amongst production firmware on consumer routers. In particular we love its VPN server and client capabilities as well as ASUS cloud services that let you access USB storage devices remotely and from a mobile. Thanks to ASUSWRT, it also lets you use a USB 3G/LTE modem in a USB port for failover internet access – though it unfortunately only has one USB port. Its only shortcoming really is the weak parental controls. The hardware is solid. It's not as advanced as the RTAC87U, but still delivers 3X3 MIMO streams for 1300Mbps/600Mbps wireless with a solid (around -60dBm) signal at range when we tested it. One of the Gigabit ports can be reassigned as a WAN port when you need it. The router also supports VDSL2, which in theory makes it ready for a VDSL NBN rollout if that should ever happen.

Verdict

It's certainly a contender for the best DSL router available right now.



Billions of uses

BILLION

ADSL MODEM ROUTER

\$143 | WWW.BILLION.COM.AU

Wireless: 1300Mbps AC, 300Mbps N; Wired: 4 gigabit ports, one gigabit WAN port, one ADSL port; USB: 2 USB 3.0 for storage or 3G modems.

Billion BiPAC 8800AXL

All networks covered.

Billion seems to have fallen off the radar of late, still, the newish 8800AXL has its appeals – not least of which is that it bucks the trend towards larger routers. It's not compact, by any means, but compared to some of the monsters here, it's dainty. It also covers all your network needs. There's an ADSL port as well as a Gigabit WAN port. It can also handle 3G/LTE modems plugged into one of its two USB ports, letting them serve as a primary of failover internet connection. Four Gigabit LAN ports round out the back. When it comes to wireless, it supports full 1300Mbps AC from its internal antennae (though weirdly only 300Mbps wireless N). It wasn't exactly a powerhouse when we tested it, however, with its signal power never better than -70dBm at 15m and transfer rates of about 14.3MB/s at that range. The firmware feature set is fairly rudimentary as well, and not terribly user friendly. Forget parental controls or router VPNs, and even the USB storage feature is quite basic.

Verdict

It's cheap, and 3G/LTE support is cool, but you can do better with everything else.



ADSL MODEM ROUTER

\$300 | WWW.DLINK.COM.AU

Wireless AC1900: 1300Mbps AC, 600Mbps N (using 3x3 MIMO) with beamforming; Wired LAN: 4 gigabit ports, one ADSL port; USB: 1 USB 2.0, 1 USB 3.0.

D-Link DSL-2900AL

Totally tubular.

D-Link has cottoned on to the notion that for some, looks matter. But it's certainly not all style over substance here. The router boasts an impressive list of features in both software and hardware. It supports three MIMO streams for both AC and N, offering up to 1300Mbps and 600Mbps respectively, the latter using the 256-QAM "hack" that not all client devices support. In spite of its unusual design, it produced a very strong Wi-Fi signal when tested, hovering around -60dBm power and transferring data at 31.5MB/s. Perhaps most impressive, however, is the redesigned firmware in the D-Link Viper. It's easy for beginners to set up and manage, but offers a lot to tinkerers. We're particularly fond of its SharePort feature, which let you browse media attached to a USB port from within a browser (in addition to the usual SMB and DLNA access), and the mydlink cloud service, which lets you access those files from outside your home network.

Verdict

A modem router with both style and substance.





ADSL MODEM ROUTER

\$300 | WWW.FRITZBOX.COM.AU

Wireless AC1750: 1300Mbps AC, 450Mbps N; Wired: 4 gigabit ports, ADSL port; USB: 2 USB 3.0; VoIP: DECT base station, PSTN failover, two analogue ports.

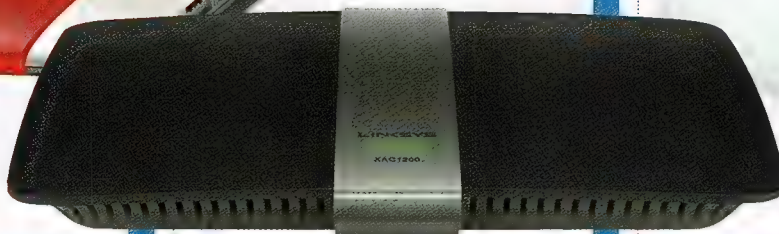
Fritz!Box 7490

VoIP is most definitely still a thing.

VoIP routers are rare these days — which is a shame, because there are real benefits to having VoIP capabilities built in. There are a few good ones left, like the Fritz!Box, which now supports AC wireless. It takes voice seriously: it's not tacked on by any means. It has PSTN failover, cloud saves of contact lists, call records, multiple voice message boxes, alarm/wake-up calls and much more. It also serves as a DECT base station for up to six cordless handsets. When it comes to voice, it's a phenomenal solution. Thanks to the upgrade to AC, it's also no slouch when it comes to other networks as well. 1300Mbps AC is supported as well as 450Mbps N, and there are four gigabit LAN ports, one of which can be re-assigned as a WAN port if you ever get the NBN. Its wireless signal was solid, around the -65dBm mark at 15m. Setup is straightforward and there are plenty of options for power users too, like some handy wireless diagnostics. It's a great product, perfect for VoIP users and pretty good for everyone else.

Verdict

Good network features and outstanding VoIP capabilities.



ADSL MODEM ROUTER

\$220 | WWW.LINKSYS.COM

Wireless AC1200: 867Mbps AC, 300Mbps N with beamforming; Wired: 4 gigabit ports, WAN port with ADSL modem bridge in power brick; USB: 1 USB 3.0.

Linksys XAC1200

A router for new users.

In terms of its core technology and features, the Linksys does very little to stand out. In terms of user friendliness, however, it's a cut above. Configuration is as user friendly as can be. You're walked through the process, with plenty of explanation. Even advanced techniques, like traffic prioritisation and USB sharing, is all drag and drop user friendliness. The XAC1200 has an unusual design that lets the XAC1200 double as both a regulation NBN-ready broadband router and ADSL router. There's no ADSL port on the router itself; it just has a regulation Ethernet WAN port. The ADSL modem is actually built into the (massive) power brick; you connect your phone line to that. While we loved the setup, the signal produced by the router's internal antennae was disappointing. At 15m, its signal strength wasn't great when we tested it: -76dBm and -77dBm respectively in the 2.4GHz and 5GHz bands. And that's on a router that doesn't boast the fastest wireless hardware to begin with.

Verdict

It's not terribly feature-packed, and the wireless is disappointing, but for user-friendliness it can't be beat.



ADSL MODEM ROUTER

\$259 | WWW.TP-LINK.COM.AU

Wireless AC1900: 1300Mbps AC, 600Mbps N (3x3 MIMO) with beamforming; Wired LAN: 4 gigabit ports (one switchable to WAN); USB: 1 USB 2.0, 1 USB 3.0.

TP-Link Archer D9

Strong wireless signal.

Aside from the inclusion of an ADSL modem and a substantial price premium, the Archer D9 is nearly identical to the Archer C9. And that's not a bad thing; it has a strong wireless signal at range and has some very good USB and bandwidth management features. The hardware is capable of 1300Mbps 802.11ac as well as 600Mbps 802.11n, although that latter comes with a caveat. Like other AC1900 devices, the Archer D9 borrows modulation tech from 802.11ac that's not officially supported by 802.11n. Given that, most client devices will see it as 450Mbps 802.11n rather than 600Mbps. The firmware keeps improving, but it still seems to float in a weird middle ground between consumer friendliness and go-nuts technical features. It has some good stuff: bandwidth metering, CD-based easy setup, USB options, DHCP-controls, firewall rules; but also some mediocre stuff, like its parental controls or lack of VPN support.

Verdict

It still falls a little short as a consumer device, but the hardware is certainly capable.



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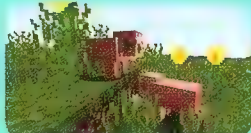
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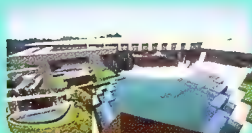
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ISSUE 01

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BROADBAND ROUTER

\$300 | WWW.ASUS.COM.AU

Wireless AC2400: 1734Mbps AC, 600Mbps N (using 3x3 MIMO) with beamforming; Wired LAN: 4 gigabit ports, 1 gigabit WAN port; Two USB 3.0 ports.

ASUS RT-AC87U

Nearly perfect.

If you asked us to describe our perfect consumer router, the ASUS RT-AC87U would come close to ticking nearly every box. It has WRT-based firmware, 1734Mbps quad-stream wireless AC, VPN client and server support, 3G/LTE modem support, cloud based access to shared storage and it comes with 100GB of cloud storage. It uses an outstanding custom WRT build, ASUSWRT. It's built on the same foundations as DD-WRT and OpenWRT, but with a consumer friendly layer on top, along with a cloud service that lets you access shared files remotely and on mobiles. And then there's the wireless hardware. It supports 4x4 MIMO for 802.11ac — which translates to a peak performance of 1734Mbps, higher than any other router we've seen. We couldn't actually test the full speed, because we don't yet have a client device that supports 1734Mbps, but tested at 1300Mbps we found we could transfer files at a little over 32MB/s at 15m, with signal power hovering at around -60dBm.

Verdict

The power is no joke, and the firmware is pretty great as well.



BROADBAND ROUTER

\$280 | WWW.BELKIN.COM/AU

Wireless AC1750: 1300Mbps AC, 450Mbps N; Wired LAN: 4 gigabit ports, 1 gigabit WAN port; USB: 1 USB 2.0, 1 USB 3.0.

Belkin F9K1115au

Very consumer friendly.

This router is so user friendly it comes in the box with all the cables already plugged in, and the setup process is very simple, with a handy guide built into the shipping box. That's not to say it isn't technically capable. As the name indicates, the AC1750 can hit 1300Mbps 802.11ac and 450Mbps 802.11n. There's also a USB 3.0 port for file sharing and media serving. When we tested it, the wireless signal strength was solid enough, hovering between -65 and -69dBm at 15m and managing throughput in excess of 28MB/s for 802.11ac. The firmware is about what you'd expect for a consumer router: it covers the basics well, but you won't find advanced capabilities like VPNs here. We should note, however, that its parental controls are particularly strong, with categorised blacklists drawn from Norton to filter adult and inappropriate content. This is streets ahead of most router parental controls, which are typically nothing more than user-made site restrictions.

Verdict

Easy to use, technically capable and with excellent parental controls.



BROADBAND ROUTER

\$329 | WWW.DLINK.COM.AU

Wireless AC3200: 1300Mbps AC (x 2), 600Mbps N with beamforming; Wired LAN: 4 gigabit ports, 1 gigabit WAN port; USB: 1 USB 2.0, 1 USB 3.0.

D-Link DIR-890L

Also a monster.

Like the similarly specced Netgear Nighthawk X6, the DIR890L is huge. And like the Nighthawk, it deploys the newest AC "spec": AC3200. That means it creates two independent 802.11ac networks, each theoretically capable of 1300Mbps. As we note in the Netgear review, we're not really sure what the point of that is outside of corner-case scenarios where you have a bunch of different devices all streaming HD video at once, but it sounds impressive. In spite of our cynical view of AC3200, the router is still impressive. It's signal power and transfer speeds were top-notch, rarely dropping below -60dBm and copying data at 32.7MB/s. The updated D-Link firmware is also a winner. It doesn't have the parental features of the Netgear, and the mobile app and media streaming setup is not as good — but the cloud service that lets you access files remotely is pretty darn useful. All up, we'd probably favour the Netgear slightly, but it was a pretty close call in the end.

Verdict

Another huge AC3200 router. It doesn't disappoint.





BROADBAND ROUTER

\$280 | WWW.LINKSYS.COM

Wireless AC1900: 1300Mbps AC, 600Mbps N (3x3 MIMO) with beamforming; Wired LAN: 4 gigabit ports, gigabit WAN port; USB: USB 2.0/eSATA port, USB 3.0.

Linksys WRT1900AC

The WRT is back, kinda.

In 2002 Linksys released the WRT54G router, which boasted revolutionary Linux-based open source firmware. Linksys later abandoned that firmware, but the open source community took it and made DD-WRT, Tomato and OpenWRT. Fast forward to 2015, and Linksys has released the WRT1900AC, a device that recalls not just the aesthetic of the WRT54G, but also claims to be "open source ready," with Linksys working with OpenWRT to make it easy to upgrade to the firmware and building in a powerful (for a router) dual core 1.2GHz processor. That doesn't mean it comes with OpenWRT, however. Instead it comes with Linksys' own easy-to-use but feature-limited firmware. Still, the hardware is capable of 1300Mbps AC wireless (despite four antennas) and 600Mbps N. There are four gigabit Ethernet ports and a gigabit WAN port, as well as a USB 3.0 port and a combo eSATA/USB2.0 port. Its signal strength at 15m was OK when we tested it, hovering around -68dBm in both bands.

Verdict

It's disappointing that it doesn't ship with OpenWRT, but the hardware is designed to handle it should you choose to upgrade.



BROADBAND ROUTER

\$290 | WWW.NETGEAR.COM.AU

Wireless AC3200: 1300Mbps AC (x 2), 600Mbps N with beamforming; Wired LAN: 4 gigabit ports, 1 gigabit WAN port; USB: 1 USB 2.0, 1 USB 3.0.

Netgear Nighthawk X6

It's a monster.

The Nighthawk X6 is enormous, and with its six antennae can drive it to unprecedented speeds — it's one of the first AC3200 routers available. There's a big asterisk next to that number, however. An individual device can only connect at 1300Mbps. The six antennas aren't used to create a single six-stream MIMO network; they're used to create two discrete 5GHz Wi-Fi networks. We struggle to see what advantage this has over, a four stream device like the ASUS RT87U. Setting aside the debatable value of AC3200, the X6 is still an excellent router. Netgear's setup and configuration is very user and mobile-friendly, and automatically detects if you have an existing network in place. Its support for media streaming to both network players and mobiles through ReadyShare is outstanding, as is Netgear's live parental controls. It also proved exceptionally speedy, with signal power at 15m never dropping below -57dBm and throughput for file copies in excess of 34MB/s.

Verdict

We're not sold on AC3200, but the router is otherwise excellent.



BROADBAND ROUTER

\$179 | WWW.TP-LINK.COM.AU

Wireless AC1900: 1300Mbps AC, 600Mbps N (using 3x3 MIMO) with beamforming; Wired LAN: 4 gigabit ports, 1 gigabit WAN port; USB: 1 USB 2.0, 1 USB 3.0.

TP-Link Archer C9

Affordable mid-range.

For a company that has only been a on the network hardware scene for ten years, TP-Link has done extremely well for itself. It's now the biggest wireless LAN equipment maker in the world by a considerable margin. More importantly, it's products have improved dramatically. The hardware was always decent, but the software on its routers has also improved. Sure, logging into the admin page still assaults you with a terrifying array of technical details, but the CD or the "Quick Start" button will walk less technical users through the setup process. Still, some things aren't covered by the quick setup, like file sharing settings for its two USB ports and the too-complex but still weak parental controls. Firmware aside, the C9 hardware is good, with three MIMO streams for 1300Mbps wireless AC and 600Mbps wireless N. It may look like a spiky haired Teletubby, but it produced a very strong signal at range in our tests with a strength of around -56dBm in 2.4GHz and -65dBm in 5GHz at 15m.

Verdict

The wireless signal clarity is a particular highlight.





RANGE EXTENDER

\$90 | WWW.BELKIN.COM/AU
Wireless: 300Mbps dual-band 802.11n with cross-band; One Fast Ethernet port.

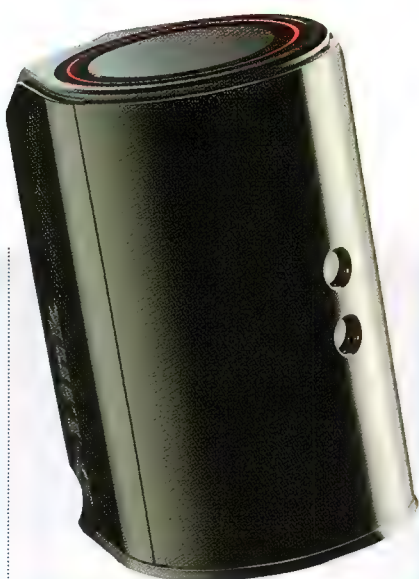
Belkin F9K1122au

Cool looking, but dated.

The Belkin N600 Dual-band Plug-in Wi-Fi Range Extender (aka the F9K1122au) might not be the most advanced range extender, but it does have a few features that make it worth a look. For a start, it's better looking than most with a consumer-friendly industrial design. It also supports cross-band, which is a major plus for wireless range extension: it means that it receives on one band (2.4GHz or 5GHz) and retransmits on the other, which eliminates one of the big problems with many range extenders – the halving of bandwidth due to retransmission. But it's still using dated technology. It only supports 802.11n up to 300Mbps, and its single Ethernet port is only Fast Ethernet (limited to 100Mbps). Meanwhile, when we tested it, its signal power at 15m was not exactly what we'd call strong, typically in the -90dBm range and occasionally dropping altogether if we held our test device just so. Given that, it's a product that's hard to recommend.

Verdict

Support for cross-band technology is good, and setup is a breeze, but the technology is limited.



RANGE EXTENDER

\$120 | WWW.DLINK.COM.AU
Wireless AC1200: 867Mbps AC and 300Mbps N; Four Gigabit Ethernet ports, one USB 2.0 port.

D-Link DAP-1650

A real looker.

Like the Netgear EX7000, the D-Link DAP-1650 is a free standing unit that's superior to any power point extender we've seen. What's more, this one actually looks pretty cool, with a cylindrical design similar to that of the DSL-2900AL Viper. It's not just a range extender, either. Like the Netgear, it also functions as a very capable stand-alone access point and wireless bridge. It supports 867Mbps wireless AC and 300Mbps dual band wireless N, has four gigabit LAN ports and a USB port. There's the excellent SharePort media sharing capabilities, including a mobile app and a cloud service for remote access. Thanks to its browser-based setup wizard (there's also a mobile app), we had it set up very quickly, and it proved quite capable. Signal power remained consistently strong to 15m, and we found we could transfer data at just under 17MB/s with a direct connection. When switched to extender mode at 15m + 15m, that dropped to an average of about 5.3MB/s.

Verdict

It looks cool and works better than any power point extender we've seen.



LINKSYS

RE4000W

RANGE EXTENDER

\$95 | WWW.LINKSYS.COM
Wireless: 300Mbps dual-band 802.11n with cross-band; Two Fast Ethernet port.

Linksys RE4000W

A quick network patch.

Like its Belkin stablemate, there are good things to be said about the Linksys RE4000W, including its excellent setup process and support for cross-band transmission to increase throughput. But it also suffers from the same flaws: dated wireless technology and (for us at least) problems with reception at range. It's also rather too large, likely dominating a double power point and preventing you from plugging anything into the point next to it. The design is otherwise pretty plain, but nicely curved with a single indicator light. It has two Fast (100Mbps) Ethernet ports. When we tested it, it generally sat at around -88 to -92dBm signal power at 15m – although we experienced no total dropouts during testing. Given that, connect rates were quite low, and we often experienced significant lag when accessing web sites over an extended network, even with cross-band active. Ultimately, cross-band and an easy setup CD are nice, but they're no substitute for 802.11ac.

Verdict

Nah. Get yourself an AC-capable extender.





RANGE EXTENDER

\$69 | WWW.MINITAR.COM

Wireless AC750: 433Mbps AC and 300Mbps N; Two Gigabit Ethernet ports.

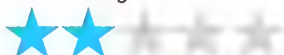
Minitar MR750AC

Just the basics, ma'am.

Minitar's MR750AC is a range extender of the power-point type, sitting discretely on a wall socket. And it is discreet, being considerably smaller than both the Belkin and Linksys repeaters. Nonetheless, it supports 802.11ac, albeit in a minimalist fashion. It's limited to just 433Mbps in the 5GHz channel. It can hit 300Mbps for 802.11n, though it doesn't appear to support cross-band. It certainly struggled to perform when we tried it out: at 15m with a direct AC connection we could transfer data at just 4.3MB/s with signal power usually in the -85dBm range. When it repeated an 802.11ac network (from the Netgear Nighthawk X6), the speed dropped to just 1.1MB/s — OK for web browsing, but forget media streaming. Oddly, the Minitar technically functions as a stand-alone router, with one of its two Fast Ethernet ports being able to be assigned to WAN duty. As a router, however, its functions are extremely minimal, with a retro interface and few options.

Verdict

It's cheap and it's small, and it technically supports AC, but there's not much else recommending it.



RANGE EXTENDER

\$250 | WWW.NETGEAR.COM.AU

Wireless AC1900: 1300Mbps AC and 600Mbps N (using 3x3 MIMO); Five Gigabit Ethernet ports, one USB 3.0 port.

Netgear EX7000

That's what we want.

The EX7000 is probably more accurately described as a free standing wireless access point and bridge with range extension capabilities. It's about the size of a full router and has a USB 3.0 port as well as a five-port Gigabit Ethernet switch, making it an excellent Wi-Fi to wired bridge. The only thing separating this from a fully functioning router is a dedicated WAN port. It supports three-stream 802.11ac, for a max speed of 1300Mbps (and 600Mbps for 802.11n, with cross-band support). That puts it at the top of the range extender heap. At 15m, we were getting better than -60dBm signal power, and direct transfer rates of around 29MB/s as an access point. Using it as an extender to the Nighthawk X6 (15m + 15m) dropped that number to just under 10MB/s, still pretty good for 30m. Set up is simple. You can use WPS, or set it up using your mobile or PC from a web browser. Setting up additional features, like ReadyShare media streaming from the USB port, is also straightforward.

Verdict

As fast and powerful (and expensive!) as range extenders come.



RANGE EXTENDER

\$118 | WWW.TP-LINK.COM.AU

Wireless: 300Mbps single-band 802.11n; Powerline: 500Mbps HomePlug AV; One Fast Ethernet port in one adapter, two in the other.

TP-Link TL-WPA4220KIT

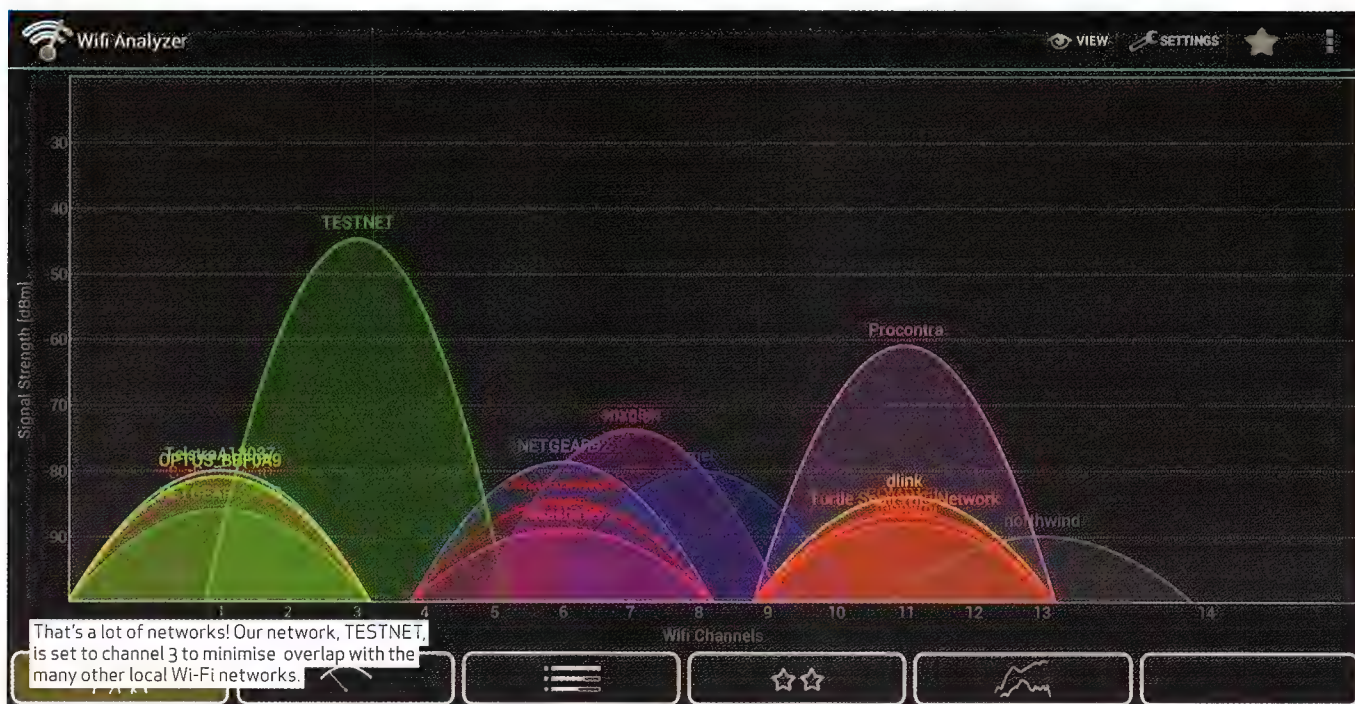
A combo device. At last!

Calling the TP-Link TL-WPA4220KIT a range extender is not exactly accurate. Unlike most range extenders, it doesn't rebroadcast a wireless signal — instead it creates its own distinct wireless network and transmits data back to the main router using a 500Mbps HomePlug AV powerline connection. And it works great, with only a couple of milliseconds of lag, and no halving of available bandwidth. It's also very easy to set up. The package looks like a regulation HomePlug AV powerline pair, but with one of the points substantially smaller than the other. The larger also houses the Wi-Fi radio (as well as a second Ethernet port). While we love the concept, there are flaws. For one, there's no AC support, only 300Mbps wireless N. For two, the wireless signal from the Wi-Fi radio was weak; at 15m it was around -85dBm. Third, it only has Fast (100Mbps) Ethernet ports, which puts a severe cap on potential speeds. Even so, the powerline Wi-Fi combo beats most range extender solutions by a long shot.

Verdict

The concept is great and the price is good. The implementation could be a little more up-to-date, however.





Set up and test your Wi-Fi

So you're finding that your Wi-Fi reception or transfer speed is flaky? Nathan Taylor helps you find out why.

Problems with speed or reception probably has something to do with how you've positioned and aligned your router, and possibly some of the router configuration options that you never bothered to check. So this month we're going to look at using a tool called WiFi Analyzer to help you get your wireless set up just right. WiFi Analyzer is a free Android app that provides an overview of all the wireless networks in a given area as well as detailed signal power information for specific networks. As a bonus, it lets you use your phone like a tricorder.

PICKING THE RIGHT CHANNEL

The first thing you can do is pick the right channel for your wireless network. For those of you who don't speak networking geek, Wi-Fi is divided into channels, which allows multiple networks to operate in the same space without stepping on each other's toes. If you use channel 3 and your neighbour uses channel 10, your data transfers won't interfere with each other.

But it's not quite as simple as picking a channel that nobody else uses. First of all, you've probably got a dual-band router by now, which means that it works in both the 2.4GHz radio band

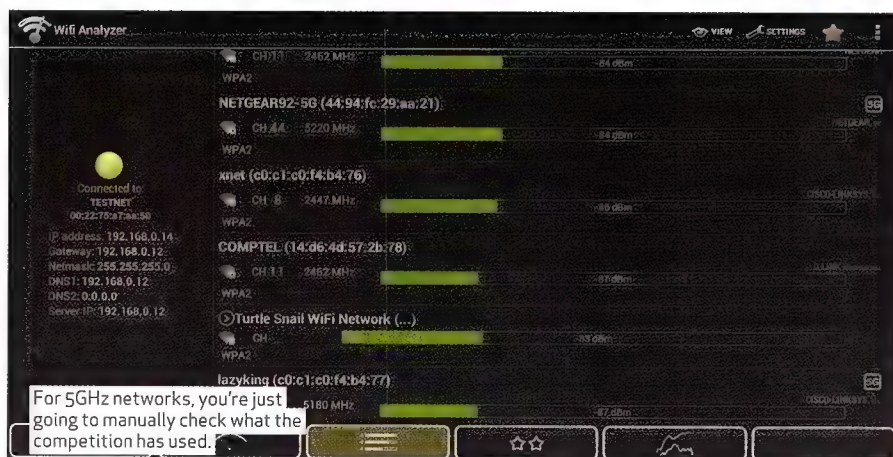
and the 5GHz band. So you have to pick two channels. Moreover, each band works differently, which we'll get to in a moment.

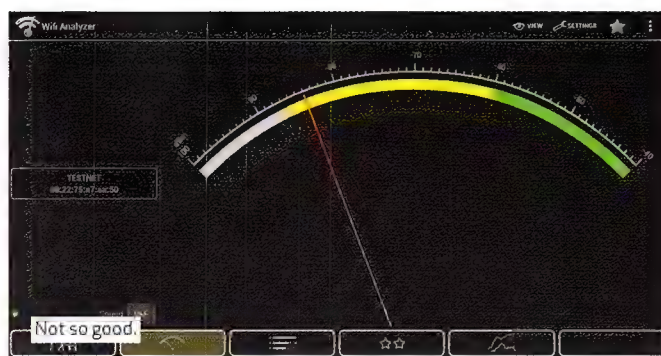
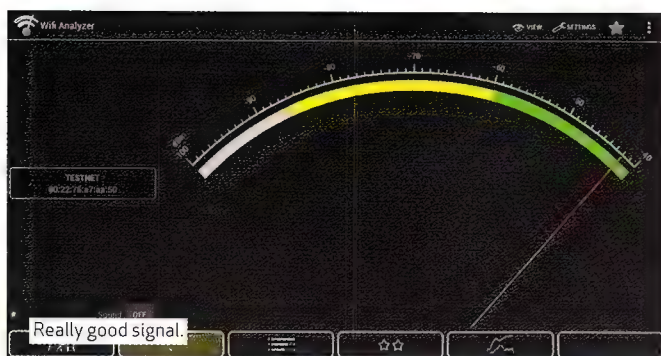
Bring your phone near to where your router is located and fire up WiFi Analyzer. The first tab you'll see when it pops up shows you a bunch of labelled curves, each representing a wireless network. The Y axis is the signal power of each network. The X axis is the channel used by that network. This graph shows 2.4GHz networks.

One thing you'll see is that networks overlap — that each curve is way more than a single channel in width. That's because channels in 2.4GHz spectrum actually overlap, and because new wireless technologies introduced since 2.4GHz was divided into channels allow more than one channel to be used at once.

What you want to do is find the channel that gives you the most "clear air" — you want the curve representing your channel to have as little as possible overlap with other networks in the area.

This may require a little guesswork on your part, but it's generally not that hard to figure out. If you tap on the fourth tab in WiFi Analyzer (the one with two stars), it will actually recommend channels for you by star





rating, but you can do just as well using the visual tool. Pick a channel and make a note of it.

That's the 2.4GHz channel sorted. WiFi Analyzer does not have a graph tool for 5GHz networks, and there's a reason for that: 5GHz channels have larger spacing and very little overlap. You just need to find one that nobody else is using. In Australia, there are commonly nine 5GHz channels available, although many routers may only have four for the purposes of international compatibility.

In WiFi Analyzer, head to the third tab. This gives a list of all the local networks by channel. Any channel with a channel number greater than 14 is a 5GHz channel (14 or less is a 2.4GHz channel). In Australia, you'll see channels 36, 40, 44, 48 used, and more uncommonly 149, 153, 157, 161 and 165.

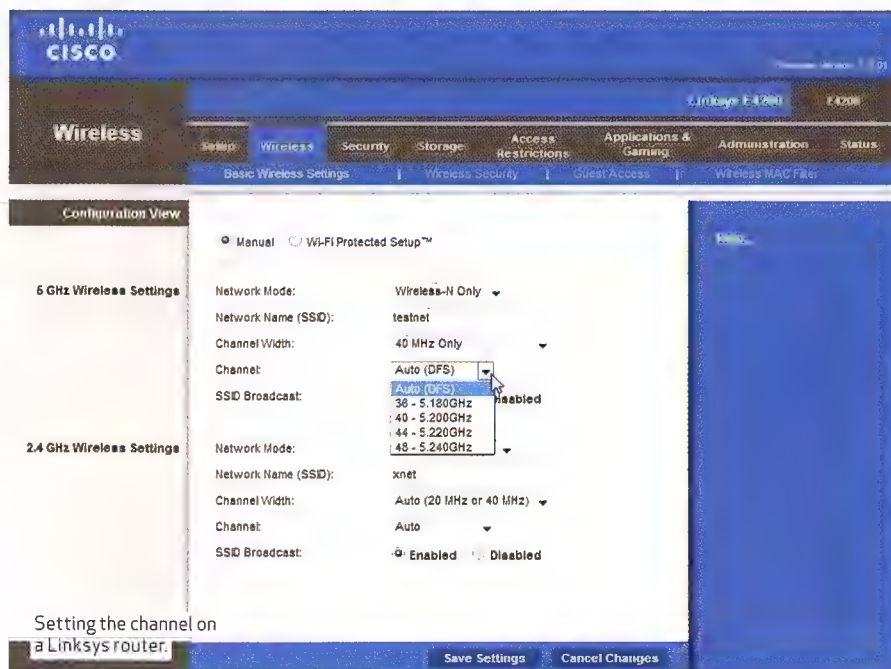
Now scroll down through the list of channels to see what other people are using. From the list of channels above (36, 40, 44, 48, 149, 153, 157, 161, 165) try to find one that nobody else is using – with a preference for one of the first four of those since your router may not support the higher level channels. If you see networks using 36 and 44, for example, you can make a note of channel 40 for your own use.

Now you've picked out channels for your Wi-Fi networks. It's time to set them up. The specifics of doing that will vary from router to router, but you need to log into your router (the router guide will have instructions for doing that) and head to the wireless settings. There should be a drop down list to choose your wireless channels for both the 2.4 and 5GHz networks. Set the channels to the ones you discovered and save your settings. That should minimise the amount your Wi-Fi is competing with your neighbours'.

GETTING A SIGNAL STRENGTH PROFILE OF YOUR NETWORK

This second part is a little easier: it's time to use your phone or tablet as a sensor, which can tell you what kinds of signal you're getting in different parts of your house.

In WiFi Analyzer, tap on the second tab, the one that looks like a windscreen wiper. This gives you



a gauge of the signal power of a single network. On the left, tap on the network name and select your own network.

If you're right next to your router, the indicator should be way over on the right, in the green. This is four-bars territory, where the received power indicator is at -60dBm or better (we won't go into what dBm is here, just note that the lower the value – and we're talking negatives here, so -100dBm is lower than -60dBm – the worse the signal power is).

Ideally, you'd like your whole home to be in this range, though for most people that's not practical. You do want to keep the bar at -80dBm or better though, while in -85dBm or worse range you're likely to start experiencing dropouts and very poor performance.

Now grab your phone and start walking around the house, to get readings in all the locations where you might need Wi-Fi. Make sure to always hold the phone horizontal (to give a fair comparison between points) and even put it down to remove your hand from the interference equation. By default, WiFi Analyzer updates every few seconds, but you can increase the rate.

Is everywhere in your home -80dBm or better? Then you don't really need to worry about anything. But if you are finding dips in the signal strength below that, you might have to start looking at remedies. There are a variety of remedies, but the number one trick is to move your router.

Try repositioning your router to be closer to the black zones (hopefully without creating new black zones). This might involve getting some longer cables, but it's generally worth it.

Otherwise, you can also try increasing the transmit power on your router if the router supports such adjustments and removing any obstructions between the router and the zone with poor reception. Fish tanks, mirrors, metal objects and many other household items can be signal stoppers.

Ultimately, if moving the router doesn't work, you may need to look at more radical solutions – an extra wireless access point, a range extender, better antennae or maybe even a new router. It's not ideal, but sometimes you have to take an extra step to make Wi-Fi work for you. ■



Setting up dynamic DNS

Nathan Taylor gets rid of your dynamic IP and give you access to your PC from anywhere.

There's some really cool server apps you can install on your home network. You'd love to set up Plex so that you can stream your movie collection to anywhere you are — or even allow friends to stream from it. A Minecraft server that's just for you and your friends. A Remote Desktop app so you can control your PC from your phone when you're out and about. A surveillance server that allows you to check in on your IP cams when you need to.

But there's a problem: you have no way to reliably locate your home server. Your ISP dynamically assigns you an IP address, and with a constantly changing IP address, it's like trying to dial home with a phone number that changes randomly.

The solution you're looking for is dynamic DNS. Dynamic DNS means that your home network will always be associated with a specific domain name. This month, we'll walk you through how to set one up.

WHY WOULD I DO THAT AGAIN?

So let's start talking about what DNS does. The Domain Name Service is actually pretty simple in concept — it's a directory that maps internet IP addresses to names more memorable to actual people. The domain apcmag.com points to IP address 89.167.142.49, for example.

The thing is, our home networks generally cannot be so mapped. That's because most consumer internet

accounts in Australia use dynamic IP. You get randomly assigned an IP address by your ISP when you connect. Reconnect, and you get a different IP. That means that trying to call your home server by IP address is impossible.

With some ISPs, you can get a static IP, but that will generally cost you extra. A better solution is dynamic DNS (DDNS). DDNS constantly updates the association between a domain and an IP address. When you get a new IP address, your DDNS address will be updated to reflect that.

The upshot of this is that you can set up your home server and have a URL that points to it permanently, regardless of your IP address. You can always access your Plex server at this address, or check in on your webcams remotely, for example.

SO HOW DO I GET ONE OF THESE?

Getting your own dynamic DNS domain name is actually pretty simple, and home users can get it for free from a number of services. We'll use No-IP in the step by step (right), but there are other addresses you can try as well.

NOPE. STILL NOT WORKING

Unfortunately, for some apps (including Minecraft) setting up DDNS is simply the first phase of the process. You still have to navigate the maze of security protocols that protect your home network from outside attack. Your router doesn't really know the difference between a hacker and

Other free DDNS providers

No-IP is one of a number of free dynamic DNS providers out there.

You can also try:

Duck DNS (duckdns.org)

Zonomi (zonomi.com)

yDNS (ydns.eu)

If you don't mind paying a small annual fee, you can also try **Dyn.com** — which recently shuttered its free service but has the advantage that a number of routers are preconfigured for it, so you don't have to install a local app — you just configure your router.

someone trying to connect to your Minecraft server.

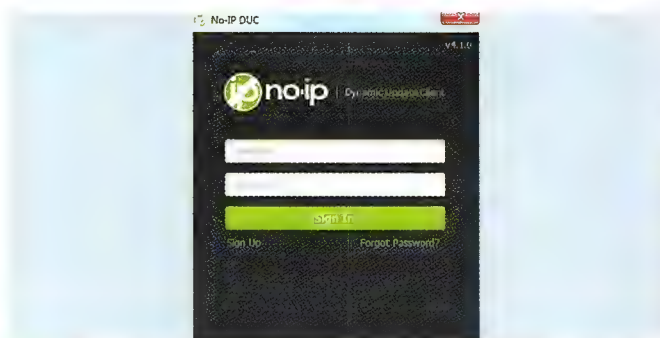
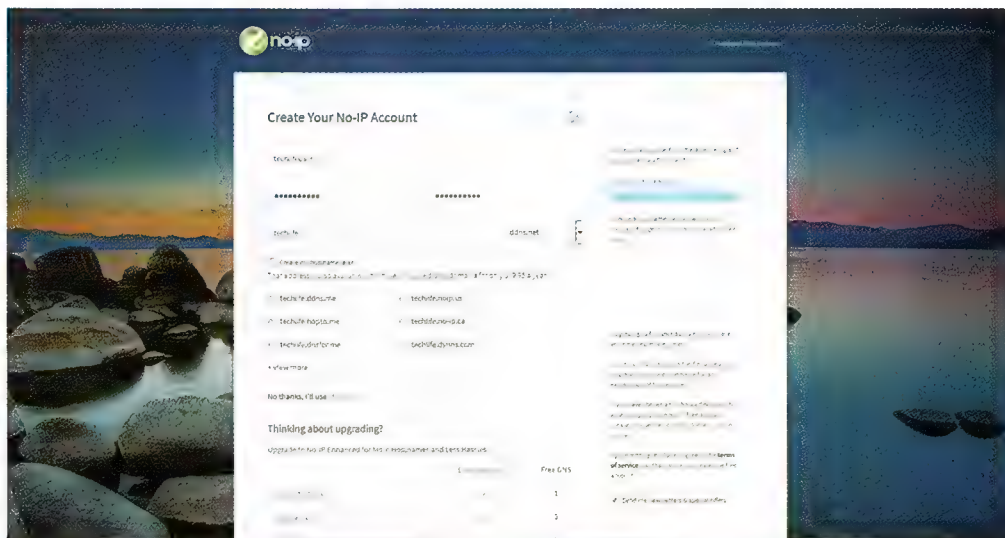
Many apps, like Plex, will automatically configure your router to direct traffic to the server and should just work, no need to change router settings. If your app doesn't "just work," however, typically what needs to be done is set up port forwarding on your router so that it knows to direct incoming traffic to the PC with the server application running. We don't have the space to provide a full guide here (we'll cover it in future issues), but a good place to start is **portforward.com**, which provides guides on setting it up for various routers.

Set up a DDNS

Create a dynamic DNS so you don't lose contact.

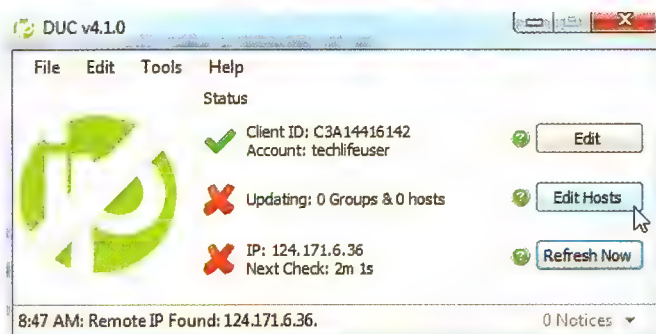
1 CREATE AN ACCOUNT AND A DOMAIN AT WWW.NOIP.COM

Head to the web site and sign up. You'll be asked to provide a username, a password, an email address and a URL you'd like to be your permanent DDNS address. On the free account, the URL will be myname.ddns.net. Make a note of your username and password — we'll need them again in a minute. After you click on the confirmation email, that's pretty much it — you've created your own private web address.



2 INSTALL THE APP

The next step is to set up your home network. A device on your home network needs to stay in contact with **no-ip.com** and update it on your current IP address. That way, whenever your IP address changes, no-ip.com can re-associate your web address with your IP address. No-IP provides a small app you can install on your PC that will do this for you. Head to **www.no-ip.com/download?page=win** and download the Dynamic DNS Update Client. Install and run the app. You'll be asked to enter the username and password you used when signing up on **No-IP.com**.



3 ASSOCIATE IT WITH A DOMAIN

Once signed in, there's one last step to undertake. You need to associate this particular client with the domain you created during sign-up. Click on 'Edit Hosts'. A list of domains associated with your account will appear. Since you signed up with the free account, there will be just the one. Check the box next to it, then click Save. You should now have ticks in all your boxes, and the URL should now point at your home network. You can click on the close button on the No-IP app window. It will minimise to your task bar, but you need to keep it running at all times.



4 TEST IT OUT

If you're handy with a command prompt, you can now try pinging the address associated with your network to see if it matches your current IP address. We'll assume you aren't so, we'll use a couple of web sites instead. First, go to **www.myipaddress.com**. The main page of this web site will tell you what your current IP address is. Now head to **ip-lookup.net**. In the domain lookup field, type in the web address that No-IP gave you (**username.ddns.net**), then press enter. It will tell you the IP address associated with that name. It should match the address given you by **www.myipaddress.com**. If it does, now everything is working.



5 SET UP YOUR APPS

Now if you have an app that you need to point at your home network, like the Plex or Minecraft clients, for example, you just need to enter the No-IP domain name in the server address field and it should point to your home network. ■

Blockade-breaking with DNS

If a VPN is too complex for you, or doesn't cover all the devices you'd like covered, Nathan Taylor says you can try a 'smart' DNS service to bypass national content blockades.

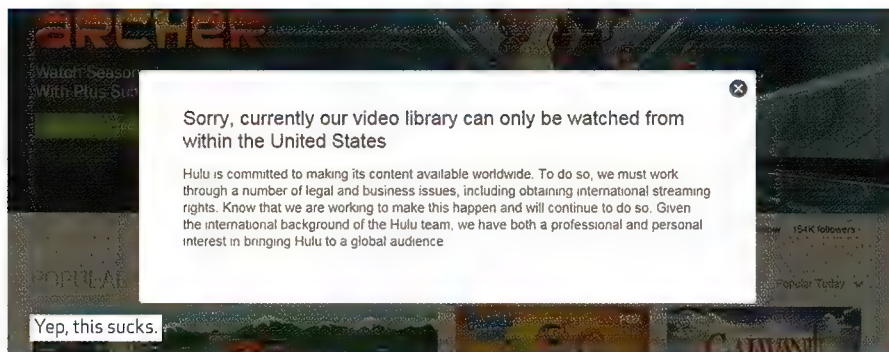
We talk an awful lot about VPNs – largely because they're good for what ails you. They keep you anonymous, add extra security, and – most importantly for many users – they hide your location so you can access geo-blocked services like US Netflix, Hulu and the BBC.

If all you want is the latter, however, a full VPN service might be a bit much. They can be difficult to share across multiple devices, can slow your connection down for things for which you don't need the VPN and can be a little too much money every month on top of your regular ISP bill.

Enter the 'smart' DNS service. There are only a handful of such services, the best known being Unblock-Us (www.unblock-us.com) and Getflix (www.getflix.com.au).

Where a VPN routes all your data through the VPN connection, these services use a different technique to bypass the blockades. What they do is provide you with a special DNS (domain name service) number that you can use in lieu of the DNS number your ISP provides you.

For the vast majority of sites, it works just like any other DNS service. But for a number of content sites, the DNS server gives the address of a proxy server run by the smart DNS provider, rather than the real site. For instance, if you go to **Netflix.com**, instead of telling you the real IP address of



Netflix.com, the smart DNS will tell you the IP address of a Netflix proxy run by the DNS provider. Since you're accessing Netflix by way of a US-server, you don't get geo-blocked.

The advantage of this model is that it's much easier to configure it for all your devices than a VPN is. A simple change in your router settings is all you really need, as opposed to complicated network connection sharing shenanigans required by VPNs. It will work for your consoles, mobiles, media players and PCs. It's also cheaper than a full VPN (\$38-\$50 per year), and doesn't slow your data down by routing unnecessary data through a VPN.

SETTING UP GETFLIX

There are two parts to setting up a smart DNS service. The first is signing up for the service; the second is configuring your devices.

What's DNS again?

DNS is the directory system that converts human-recognisable internet addresses — like **www.apcmag.com** — into numerical IP addresses that computers can understand. When you go to a site using the web address, your computer makes a call to a DNS server to ask it what the IP address is.

We'll walk you through the Getflix process; the Unblock-Us process is very similar.

The first thing you need to do is sign-up. Head to www.getflix.com.au and create an account. It has a 14-day free trial available, and costs \$4 per month after that. Once you've set up

GETFLIX Home Channels Setup Pricing FAQ Manage Support Logout

Dashboard

IP Address Status

Your Getflix subscription is tied to your IP address. Your IP address may change from time-to-time, if this happens, you can register your new IP address below.

Registered IP 124.169.5.141

Current IP 124.169.5.141

✔ Your current IP address is registered, you will be able to unblock services from this IP address.

[Force IP Update](#)

[Click here for more information](#)

DNS Status

The DNS test checks that your DNS settings are configured correctly on this device. If you recently registered a new IP address or changed your DNS settings, it may take a minute or two before this test passes.

DNS Test Result: Failed

Subscription

Status: Trialling (14 days remaining)

Expiry Date: Feb 4, 2015

[Click here to make changes...](#)

Region Settings

You can change which country you would like to appear in for some services. Below are your current settings.

Netflix: United States

Amazon Prime: United States

Crackle: United States

WD TV Live: United States

Sony TVs/BD: United States

[Click here to make changes](#)

Support Tickets

Getflix support is available 24 hours a day, 7 days a week.

Dynamic DNS

If you use a Dynamic DNS service, such as DynDNS or No-IP, enter your domain name below and we'll keep your IP address updated automatically. Check out this article for more information.

Dynamic DNS Domain e.g. myname.dyndns.org

☐ Use slow DNS lookup. What's this?

[Save](#)

IP Address Update History

The following table shows your recent IP address updates, when they occurred and how they occurred.

Timestamp	New IP Address	Update Method
21/01/2015 9:32:58 AM	124.169.5.141	Getflix Website

Setting up DDNS isn't strictly necessary, but it means you don't have to re-register your IP address every time it changes.

Network Setup

Router Address

IP Address: 192 . 168 . 0 . 23

Subnet Mask: 255.255.255.0

Device Name: CiscoD1125

DHCP Server Setting

DHCP Server: ☒ Enabled ☐ Disabled DHCP Reservation

Start IP Address: 192 . 168 . 0 . 1

Maximum Number of Users: 50

IP Address Range: 192 . 168 . 0 . 1 to 22
192 . 168 . 0 . 24 to 51

Client Lease Time: 0 minutes (0 means one day)

Static DNS 1: 54 . 252 . 183 . 4

Static DNS 2: 0 . 0 . 0 . 0

Static DNS 3: 0 . 0 . 0 . 0

WINS: 0 . 0 . 0 . 0

Just type the number for your location in.

GETFLIX Home Channels Setup Pricing FAQ Manage Support Logout

Dashboard

- IP Address
- Regions
- Subscription
- Account
- Advanced

DNS Status

The DNS test checks that your DNS settings are configured correctly on this device. If you recently registered a new IP address or changed your DNS settings, it may take a minute or two before this test passes.

DNS Test Result OK

It looks like your DNS is configured correctly. You should be able to access blocked services on this device.

Crackle United States

WD TV Live United States

Sony TVs/BD United States

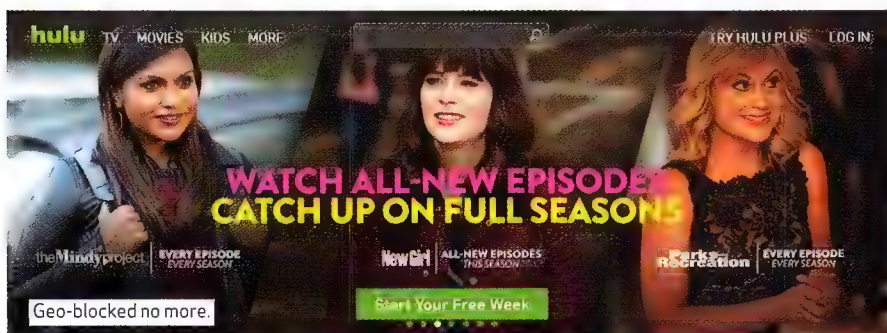
[Click here to make changes...](#)

Support Tickets

Getflix support is available 24 hours a day, 7 days a week.

Please don't hesitate to contact us using the link below or by sending an email to: support@getflix.com.au

Sweet!



your account and logged in, you'll be taken to the Getflix dashboard.

It's a good idea to bookmark this page. For Getflix to work, you need your current IP address registered with them. If your IP address changes (which likely happens whenever your router reboots), you need to come back here to register.

It's actually a really good idea to have a DDNS service set up — a process we covered previously (see Setting up dynamic DNS, page 56). You can register your DDNS domain with Getflix by clicking on 'IP Address' on the left hand panel and entering your DDNS address in the Dynamic DNS field. This way, you don't have to worry about updating your IP address registration; it will be done for you automatically.

As long as your IP address is registered, you've done everything you

need to here. Now you just need to configure your router.

CONFIGURING YOUR ROUTER

This is where the genius of the smart DNS service kicks in. If you use automatic network settings (known as DHCP) for devices on your network, they will automatically take the lead from your router when it comes to DNS settings. So to get it to work for all your devices, you just need to change your router's DNS configuration and that will propagate to any device that connects to your network. You can also configure the DNS of devices manually if you like, but for most people a one-and-done router configuration is the way to go.

Unfortunately, as we often find when talking about routers, the different manufacturers are totally inconsistent with respect to where the DNS settings

The war on the war on blockades

Under pressure from content providers, Netflix and Hulu have recently begun moving against VPN services providers as well as services like Unblock-U. At the time of writing, both worked just fine for us, however, it should be noted that — although the providers often use pejorative terms like "VPN pirate" — bypassing geo-blocks is not illegal under Australian law. You may technically be breaching Netflix or Hulu's terms of service, but you're not breaking any copyright laws.

are found. You'll need to log into your router's configuration and find the DNS settings:

On Linksys routers, they're found on the main Basic Setup page under DHCP Server Setting (it's the Static DNS fields).

- On an iiNet BoB, it's under 'System > DNS'.
- D-Link, click on Manual Internet Connection Setup and change only the DNS server fields.
- On most ASUS routers, click on WAN, head to WAN DNS settings and uncheck the automatic settings.
- On Netgear, click on Basic Settings on the left, then Use these DNS servers.
- On TP-Link, click on DHCP in the left hand panel, then on DHCP Settings.

The goal is to manually enter DNS values for you router. The DNS number you enter depends on your location: if you're in or near Sydney type in 54.252.183.4; Melbourne is 168.1.79.229; Perth 202.59.96.140; Auckland 120.138.27.84. Although there might be several DNS fields, you only need to fill in one. (Note: If you go with Unblock-U, its DNS servers are 111.118.175.56 primary and 118.127.33.48 secondary).

Save and reboot your router. You'll likely need to head back to the Getflix Dashboard page to re-register your IP address with them. Hopefully now it will also say that your DNS Status is OK.

Now you should be good to use the services that Getflix supports — including Netflix, Hulu, BBC iPlayer and many others. You can access them on all your devices (assuming the devices use automatic internet configuration) — your consoles, mobiles and media players should just work with the Netflix and other apps. You may need to reboot some devices to get them to update again. ■

Sharing your VPN connection

Nathan Taylor shows you how to open up your VPN so any device in your house can access it.

So you've set up your VPN on your PC and it's great. But what about all your other stuff? What if you'd like to run your network media player through it in order to be able to use the Netflix or Spotify apps? What about your mobiles, your consoles? Well, with a small amount of work, you can use your Windows PC to create a dedicated hotspot through which any device in your home can access your VPN connection.

It's pretty simple, really: in Windows 7 and 8, you have the ability to create a virtual Wi-Fi hotspot. This turns your PC into a Wi-Fi access point to which other devices in your home can connect. Then you use Internet Connection Sharing to share the VPN connection so that devices connecting to the hotspot you created can use it to connect to the internet.

To do this, your PC will need wireless capabilities. If you're using a desktop computer without wireless, you can use a USB Wi-Fi adapter. VPN sharing will only be active when the PC is switched on and connected to the VPN network.

PART 1: CREATING A VIRTUAL HOTSPOT

Unfortunately, Windows doesn't provide a convenient graphical user interface for setting up a virtual hotspot. We actually have to use command prompt commands to get one up and running – which may please any DOS grognards among you, and possibly terrify any whippersnappers who never experienced the joys of the

command prompt.

Instead of actually firing up CMD, however, we're going to create a .bat file, which is a script of command prompt instructions that can be run just like an .exe file, just by clicking on it. We're doing it this way because every time your computer reboots, Windows will stop the virtual hotspot and you have to restart it. If you make a .bat file, however, you can just right click on the file and Run as administrator to reset the virtual hotspot. You can also put it in your Startup folder to run

<Password> with the password you want to use:

```
netsh wlan set hostednetwork
mode=allow ssid=<SSID>
key=<Password>
keyUsage=persistent
netsh wlan start
hostednetwork
```

3 Click on 'File > Save As'. Now this part is important: you need to change the default .txt extension to .bat. Change the Save as type to 'All files', then type in a filename with a .bat at the end of it.

"...which may please any DOS grognards among you, and possibly terrify any whippersnappers who never experienced the joys of the command prompt."

automatically when Windows starts.

Before we go ahead and create the .bat file, it's important to know that you have to have administrator rights to create a virtual hotspot. You can right click on the .bat file and select Run as administrator.

So, to create the .bat file, just follow these few steps:

- 1** Open Notepad (or any other text file editor). You can use the Windows search function and just type **notepad** and press enter to find it quickly.
- 2** Type the following lines into the text editor, replacing <SSID> with the name you want your virtual hotspot to have (eg. VPN) and

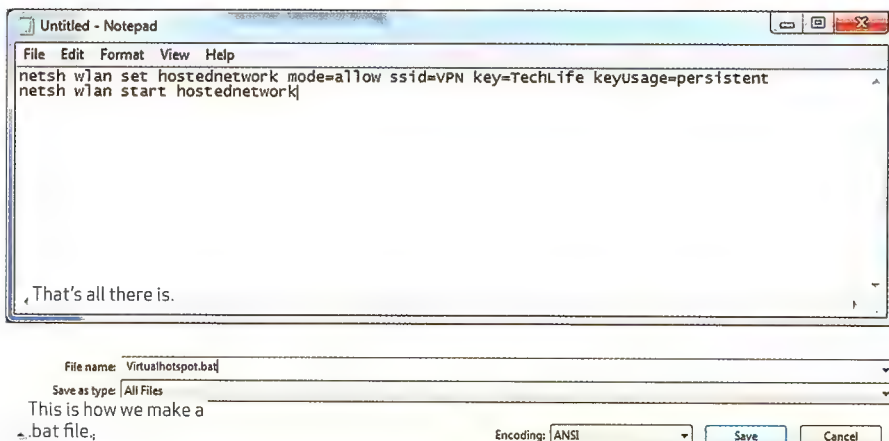
4 Run it. You can close Notepad now. Then go to wherever you saved the .bat file and right click on it and select Run as administrator. The command prompt will briefly pop up and then disappear. Your PC will now be a virtual hotspot. You can check that it is by going to 'Control Panel > Network and Internet > Network and Sharing Center > Change adapter settings'. Your list of network connections will include an extra one labelled with 'Microsoft Virtual WiFi Miniport Adapter.'

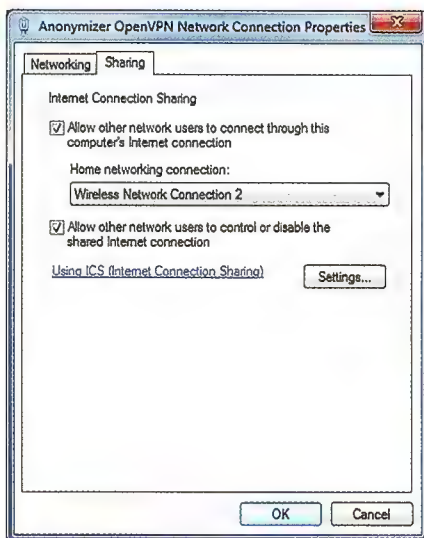
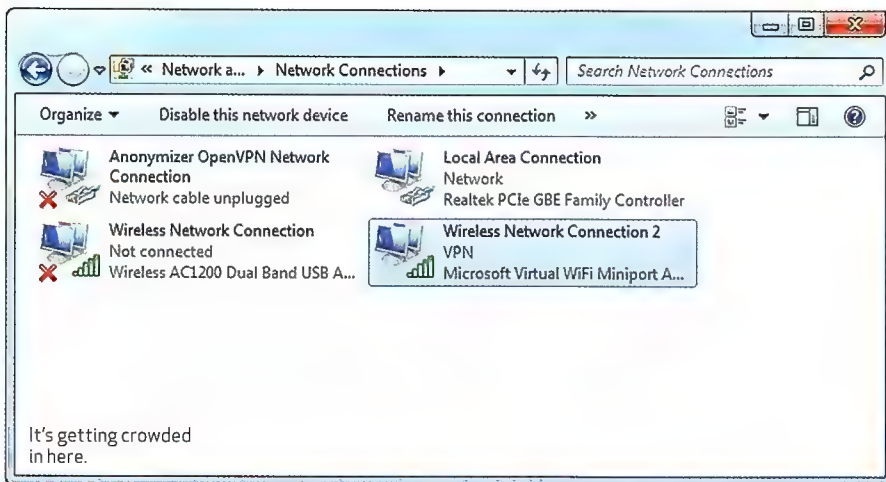
5 Connect to it with your other devices. The new wireless hotspot should appear in the list of available wireless networks on your mobile and other devices. Just connect to it using the password you entered into the text file. They won't have internet access yet: that's the next phase.

PART 2: SHARING

Now that you've got your virtual hotspot up and running, it's time to share your VPN with the devices connecting to it. This is super-easy.

1 Go to 'Control Panel > Network and Internet > Network and Sharing Center > Change adapter settings' to see your list of current network devices. When you installed your VPN app, it will have created a new adapter for you – that's your VPN connection. Now we just have to share it.





2 Right click on the VPN adapter, then select Properties. Then click on the Sharing tab. Check the box to Allow other users to connect through this computer's internet connection. Under Home networking connection: select the network device that corresponds to the virtual Wi-Fi device you've just created. Most likely, it will be Wireless Network Connection 2.

Then click OK. This turns on Internet Connection Sharing for the virtual Wi-Fi network.

3 Surf away! Now any devices that connect to your new Wi-Fi hotspot will be routed through the VPN, giving them anonymity and a virtual location to access country-restricted services, just like on your PC.

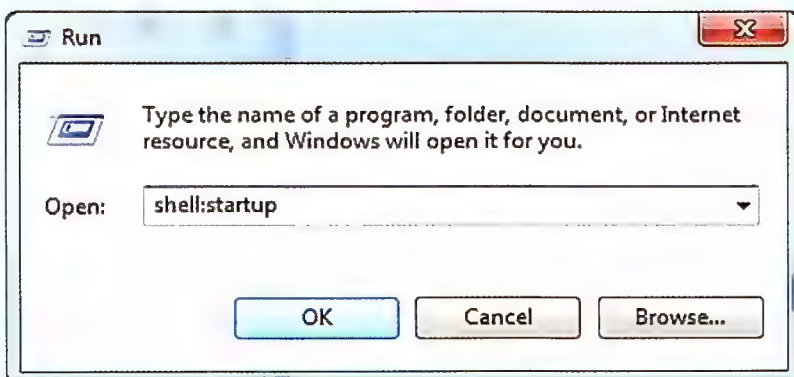
You're all done here.

So where's my startup folder?

Putting your .bat file in your startup folder makes sure that it starts whenever Windows does. Just copy and paste the .bat file into the folder. In Windows 7, the folder is easy to find. Just click on the Start button, then on All Programs, then right click on Startup and select Open.

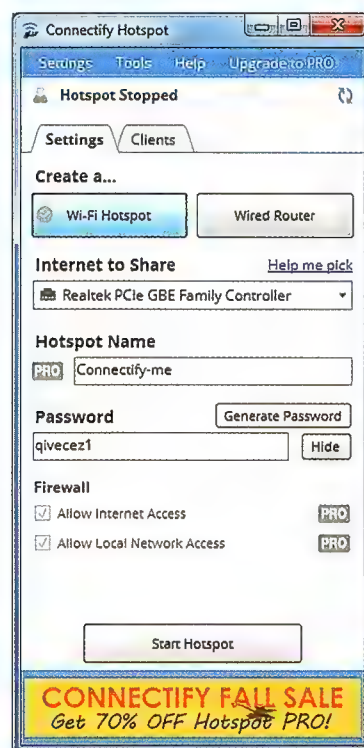
In Windows 8, it's a little harder. You can use Windows Explorer to navigate to 'C:\Users\<User Profile folder name>\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\Startup (where <User Profile folder name> is your user name)'. Or you can go to All Apps, select the Run app, then type `shell:startup` into the Open: field.

Note that you'll likely have to configure the file to always run as administrator; you do that in the compatibility tab of the Properties window.



Connectify

One you've created the .bat file, it's not too difficult to maintain the virtual Wi-Fi hotspot. But if even a little bit of command prompt action is too much, you can try Connectify (www.connectify.me), which does pretty much the same thing. You'll need to pay for the Pro version, though — the free 'Lite' version has time limits that make it close to useless.



Can't I just use my router?

You can indeed set up your router so that all traffic from all devices is routed to the VPN — assuming your router supports VPNs. Not many consumer routers do — only a handful of models from companies like ASUS and Billion come with native support for it. If you're willing to go hardcore, though, you can install open firmware like DD-WRT or Tomato on your router, which do support VPNs. You just need to be very careful and follow the online instructions.

Your VPN provider will likely provide details on the VPN configuration and hostnames you need to use if your router supports VPNs. PPTP and L2TP are typically the easiest to set up; OpenVPN is more secure, but it's extremely technical to set up in DD-WRT and Tomato. ■

Range extenders are not quite the panacea that many people seem to think they are.

Yes, we know we're wading into a holy war here, but the fact is that Samsung has the goods when it comes to Wi-Fi performance right now. The Galaxy S5, for example, supports 802.11ac, HT80 and MIMO.



Five Wi-Fi mistakes (and how to fix them).

Nathan Taylor shows you what not to do when setting up and using your network at home.

Home networking is a complex business. Sure they've made getting the basics up and running grandma-friendly these days, but if you really want to keep your network safe, get maximum speeds and build space-agey tools like IP camera networks and home automation, it takes a little know how. That's what this superguide is about.

For this feature we thought we'd look at the basic mistakes that people are making with their home wireless networks. These are the reasons that you can't even stream a 720p video from YouTube to your mobile without it stuttering and buffering, let alone a full HD downloaded movie. They're why you get crappy reception in some parts of your home, and why you're getting massive lag while playing online games. We're not even talking about security — that's a whole other kettle of fish. We're talking about the things that people so often do to cripple their own Wi-Fi networks. Fix these things, and your home network experience will go a whole lot smoother.

1 PUTTING THE ROUTER IN THE WRONG POSITION

Nothing affects your wireless performance so much as where you put your wireless router. Nothing even really comes close. The closer you are

to the router, the better reception you get, it's that simple. In most homes, however, you have one of two scenarios: 1. Where goes my ADSL/cable plug, there goes my router and 2. I'm gonna bury this plastic monstrosity in the deepest, darkest hole I can find so that nobody ever has to lay eyes on its hideousness.

Both methods often work out badly. First, you want to have the router at the epicenter of your wireless activity. Second, wireless likes clear air. The more stuff between the router and the thing it wants to talk to, the weaker the signal. Some materials like brick, concrete, tiles, mirrors, water and metals are major showstoppers.

The very worst thing you can do is put the router in an attic or basement. As anyone who has tried to set up a wireless network in a multi-storey home can tell you, signal reception on the vertical axis is usually much worse than on the horizontal.

While router antennae are usually technically omnidirectional, they are nearly always aligned to have much better signal reception along the horizontal plane.

2 THINKING IT'S ALL ABOUT THE ROUTER

So you've gone out and bought the fanciest, most tricked out router or wireless access point you could find. This thing scored 10 out of 10 in every

review you read, has the fastest wireless performance available and is undeniably the Rolls Royce of routing equipment. And then your wireless performance still sucks.

That's because you forgot that there are two parties involved in wireless communications, and it may be the other end that's messing things up.

Let's be frank: the Wi-Fi performance of many mobiles and tablets is abysmal. There are multiple implementations of the 802.11n and 802.11ac standards, and mobile manufacturers often go with the one that's cheapest to implement and has the lowest impact on battery life. That's because they know that most users don't bother to check on the details, other than to see if it supports Wi-Fi.

For the record, the best wireless implementation in mobiles is one that supports three things: 802.11ac, HT80 and MIMO. The first one, 802.11ac is the latest and fastest Wi-Fi standard available. The second is the size of the Wi-Fi channel supported, in MHz; an 80MHz channel is the largest channel size commonly in use right now. And MIMO uses multiple antennas to double the total bandwidth available. These factors are the difference between a phone capable of 867Mbps Wi-Fi and one with a cheap 72Mbps 802.11n/HT20/single antenna setup. If you're looking at phone vendors right now, Samsung is quite frankly



way out ahead of the pack when it comes to wireless, with many of its Galaxy phones and tablets supporting the latest standards (the S5, for example, checks all three of the above boxes). HTC, Nokia and LG have fair implementations in some of their higher-end phones (typically single antenna 802.11ac), while Motorola is a bit spotty. Sorry Apple fans – the company has yet to release an iPhone or iPad that even supports 802.11ac.

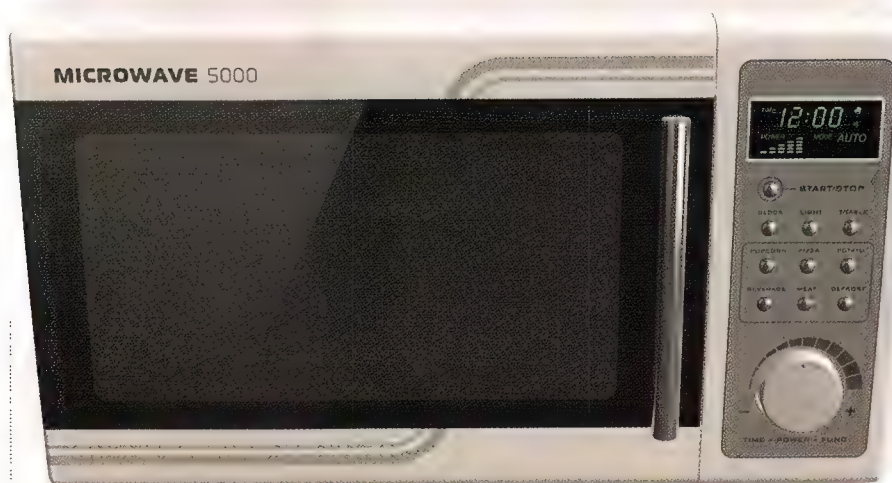
3 USING THE WRONG BAND AND CHANNEL

It's 2014, and it's a fair bet that every one of your neighbours has a wireless network of their own, which makes for a lot of competition on the airwaves.

The thing about wireless is that it's a shared medium, which means that when your neighbour is using their Wi-Fi, your Wi-Fi will suffer. That's why wireless routers have multiple selectable channels, to try and cut down on those kinds of shenanigans. If you're using channel 3 and they're using channel 9, you're actually not fighting them over airtime.

Changing channels is not something that most users think of, however, since it requires delving into some scary looking router settings. Our best advice is to install WiFi Analyzer on an Android mobile – it's available from Google Play – which will tell you what channels are being used in your local area and recommend a channel for minimal interference. Then you just have to go to your routers Wi-Fi settings (yes, we know you were never hoping to have to look at them again) and set the channel.

The other big thing is whether to use 5GHz or 2.4GHz. With the newer 802.11n standard that's not a choice, since it only works at 5GHz, but for 802.11n you can go either (or both). It's a complex technical story about which is better, but the nickel version is that 2.4GHz has better range characteristics and travels better through walls, while the 5GHz version suffers less from interference from other devices and has cleaner airwaves. Try them both out, and see what goes faster for you.



Even your microwave can interfere with 2.4GHz Wi-Fi, but it won't affect 5GHz.

Ethernet cable beats Wi-Fi, every time.



4 TRYING TO BOOST PERFORMANCE WITH A RANGE EXTENDER

We're not going to go so far as to say that range extenders are horrible in all situations. But we will say that they're horrible in most. Their only value is to extend a wireless network into places where it is otherwise unreachable. They will never improve the performance; a weak but steady signal without a range extender is better than a strong signal with one.

What range extenders do is retransmit data on the same channel. That introduces lag as it processes and retransmits, and it cuts the bandwidth in half, since both the original and retransmission will be on the airwaves at the same time. Instead of improving your wireless performance, it guts it.

If you're having major performance issues in one part of your home, it may be better to get a second wireless access point and create an entirely separate Wi-Fi network, on a different channel, and link it back to your original network with a wired cable.

5 USING WIRELESS WHERE WIRED IS AN OPTION

It doesn't matter what the specs say: wired networks are better than wireless ones. If you're hooking up a stationary device like a TV, a desktop PC or gaming console, you're better off with wired 100% of the time. There are two reasons. First, the gap between theoretical and actual speed is much smaller with wired. You'll typically get 60-80% of the advertised speed on a wired Ethernet link, while on wireless that number generally goes from about 1%-60%, depending on range, noise, contention and a million other factors. The second is that wired Ethernet is reliable. You won't get sudden and inexplicable speed drops or disconnects. The latency is also extremely low, important for gaming and voice, and there's no danger of being hacked. In short, string that cable. ■

LINUX:

The complete n00b's guide

Curious about Linux but not sure how to traverse this unfamiliar territory? Mayank Sharma will help you get started so you can join the growing ranks of Linux users.

There's never been a better time to get into Linux. It's slicker than ever, easier to install than ever and all the big-name distros like Ubuntu, have just received updates. So we think it's time for a fresh start with a fresh install.

If you've never touched Linux before never fear, we've got a complete guide to get started.

One of the biggest impediments to widespread Linux adoption is that you don't get Linux on a PC from your local store — getting Linux onto a PC is a more involved process. But the advantages a Linux desktop offers over the other mainstream OSs are well worth this extra step. For starters, Linux is open source, which is to say that you can legally download a copy of Linux and install it on all your computers. It also ships with a ton of software and you can download more with a single click.

Unlike proprietary OSs, a Linux flavour (or distro) is very malleable.

You can swap out any of the default apps or even its entire interface and replace it with something more suitable to your needs. Choice is another hallmark of Linux with multiple options from simple components to complex suites.

Furthermore, besides being compatible with all your newer hardware, Linux can also turbocharge hardware that's past its glory days. To top it all, you can do everything you can on a Windows box. From streaming video to playing the latest games, a Linux desktop will work just as well for you as any other system.

"To top it all, you can do everything you can on a Windows box"



Ubuntu

The most commonly known Linux distribution (often abbreviated to distro), Ubuntu pays special attention to desktop usability. In the 10 years of its existence, Ubuntu has galvanised the development of Linux on the desktop and is the go-to distro for third-party developers and vendors who want to run their wares on Linux.



Fedora

Red Hat's open source offering to the world, Fedora is known for adapting and offering new technologies and software to its users. Over the years, the distro has managed to find a clever balance between offering new features and stability to its users, which makes it popular with both new and experienced Linux campaigners.



Mageia

Although it's just had four releases to date, Mageia has a pedigree in usability that dates back to the 1990s. Mageia is a community project that's supported by a non-profit organisation, which is managed by a board of elected contributors. The distro is known for its customised user-friendly tools for managing the installation.

INSTALL LINUX

All you need to know to anchor Linux on your computer.

The Linux installation process is involved but it isn't actually that cumbersome. The exact installation steps are slightly different for every distribution, but in general the distro's graphical installer will guide you through all of the necessary steps pretty easily.

In essence, installing Linux is very similar to installing a piece of software, albeit with a few caveats:

DISK PARTITIONING

Unlike a piece of software, installing Linux requires you to create a dedicated partition on your hard disk. This isn't an issue if Linux will be the only OS on this computer. However, if you're installing Linux alongside another OS, such as Windows, you'll have to take steps to preserve the existing data. Many Linux distros will offer to partition the disk for you automatically, though you can create partitions yourself with ease from within Windows using the Disk Management tool (see Make Room for Linux, below). The advantage of manually partitioning your disk is that you get to decide how much space to allocate to Linux.

When creating partitions remember to create two new partitions. The bigger one with at least 12GB of disk space is for the OS itself, which you'll format as ext4. You'll also need to create a second partition for what's called swap space. In simple terms, the swap partition extends the amount of physical RAM

on your computer. A general rule of thumb for computers with a small amount of RAM (one or two gigabytes) is to create a swap partition that's twice as large as the amount of RAM on your computer. For computers with more RAM, it's best to create a swap partition that's the same size as the amount of RAM you have.

SECURING DATA

During the installation process, many distros including Fedora and Ubuntu will give you an option to encrypt the Linux partition. This option gives you an added layer of security by insulating your data from unauthorised access. To enable this option you will need to supply a passphrase which will then act as the key to unlock the data.

Another important step during installation is setting up a root account. On most distros this step is part of the user creation process where you define the login credentials of your regular user account. The regular user doesn't have any permissions to modify the system while logging in as root gives you complete control over your system.

DUAL BOOT

One software you should be familiar with when installing Linux is the bootloader. It's a small program that tells the computer where to find the different OSs on the disk. Most Linux distros use the Grub 2 bootloader.

In general, you shouldn't have to do anything here, even when installing

Linux on a Windows 8 computer that uses the UEFI BIOS with Secure Boot enabled. The latest versions of most mainstream distros, including Ubuntu and Fedora install a UEFI-compatible bootloader that will work correctly out of the box. However, since different vendors implemented UEFI differently, you might not get to the Grub bootloader screen and instead end up booting straight into Windows after installing Linux. In such a case, you should consider enabling the Legacy BIOS mode wherein the UEFI firmware functions as a standard BIOS. The option to enable Legacy BIOS is under the UEFI settings screen.

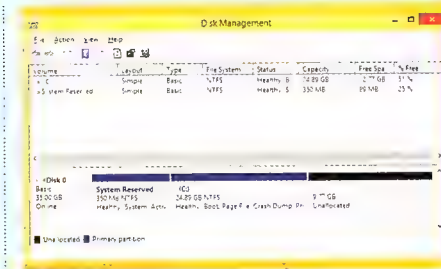
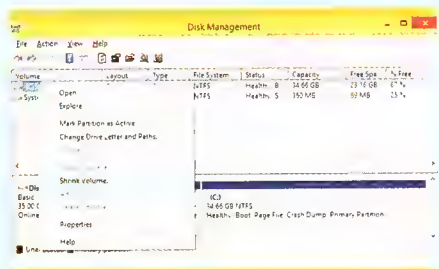
TESTING BEFORE INSTALLATION

Almost every mainstream distro, including Ubuntu, Fedora and Mageia allow you to boot into a 'live' environment, which lets you experience the distro without disturbing the contents of your hard disk. You can use the live environment to get familiar with the distro and also verify the compatibility of your hardware with the distro.

Also note that Linux distributions are distributed as ISO images. You can burn them to a CD or DVD, depending on their size, using the option to burn ISO images. You can also transfer ISO images to a USB drive. There are tools, such as UNetbootin and Yumi that will create bootable USB drives with the ISO of your distro, while Mageia recommends using the Rufus utility.

Make room for Linux:

Resize a Windows partition.



1 SHRINK WINDOWS

Before you can partition your disk you'll need to squeeze your Windows partition to free up some disk space for the new partition. Head to the Disk Management tool, and right-click your main partition that is typically assigned the drive letter C. Then select the Shrink Volume option from the pop-up menu.

2 CREATE NEW PARTITION

The Shrink dialog box shows you the total size of the drive and the maximum amount of shrink space available. You cannot squeeze more space out of a drive than the size shown here. To create a new partition, specify the size of the partition in the space provided in MB and click Shrink to start the process

3 USE THE PARTITION

After the process is complete, a new partition showing the amount of free, or unallocated, space appears next to the Windows C: drive partition. You can then point your Linux distro's installer to this free space. Remember to repeat the process and create another partition for the swap space as well

DISTRO DIFFERENCES

Taking baby steps with Linux.

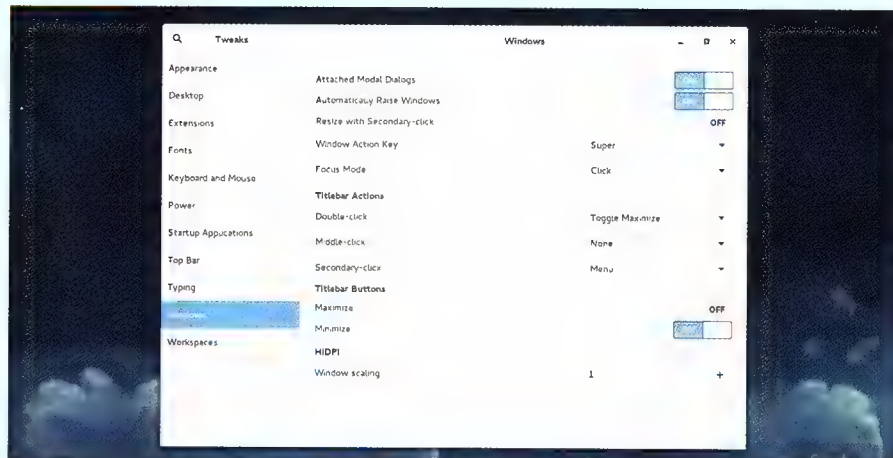
One of the biggest difference that foxes users coming from proprietary OSs is the lack of a consistent 'look and feel' to the Linux desktop. The default desktops on Ubuntu, Fedora and Mageia distros all look and behave differently from each other. We say default because unlike other proprietary OSs, a Linux distro enables you to swap out the desktop and replace it with an entirely different one to better suit your workflow.

The idea of the desktop as a separate entity from the operating system sounds foreign to users coming from Windows or Mac. But like all things Linux and open source, users are spoilt for choice when it comes to putting a face on top of their Linux distro.

UNITY IN DIVERSITY

The Ubuntu distribution uses its own home-brewed Unity desktop. The most prominent component on the desktop is the vertical Launcher which functions pretty much like a taskbar. It houses icons for the frequently used apps for quick access that you can modify as per your requirements. Also, some icons have specialised right-click context menus that give you quick access to frequently used features.

The first icon on the Launcher brings up the Dash, which is Ubuntu's take on the traditional menu-based navigation system. It features a search box at the bottom and anything you type here is used to look for matching apps, documents, music, videos, instant messages, contacts and other content. Furthermore, you can also use the Dash to install and uninstall apps and preview media files. Unity also



includes the Heads Up Display (HUD), which is an innovative take on the application menus. Using HUD helps you avoid the trouble of looking for options embedded deep within nested menus. To access HUD press the Alt key from inside any app and use the Dash-like search box to perform a task.

The default Unity experience is the result of extensive usability research by Canonical. But you'll find some options to tweak the desktop from under the System Settings tool accessible via the gear & spanner icon in the Launcher. The settings are grouped into three broad categories. The Personal group houses settings for customising the look and feel of the desktop by changing the wallpaper and modifying the behaviour of the launcher. Pay attention to the Online Accounts settings which you can use to sign into several online services, such as Facebook and Google Docs, and integrate their contents with the

desktop apps. For example, adding your Flickr account will integrate it with the Shotwell photo manager.

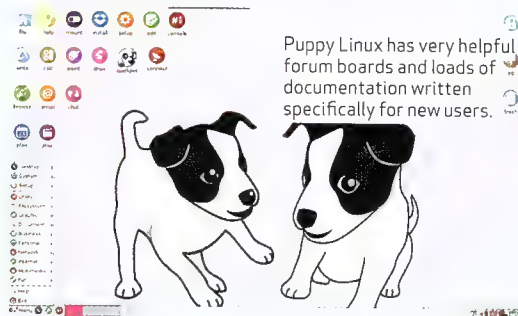
GNOME THYSELF

Gnome is another popular desktop, and the Gnome 3 desktop contains more or less the same elements as Ubuntu's Unity but presents them in a different way. For starters the desktop is very bare. Click on the Activities button in the top-left corner to reveal the Overview which is very similar to Unity's Dash. In this view, you also get a Launcher-like Favourites bar for accessing frequently used apps.

In the centre you get a preview of all open windows. To the right is the Workspace Switcher, which always shows the current Workspace and an additional one. If you add windows to the second Workspace, a third will automatically be added. At the top is a search box that will match any text to

Resuscitate an old workhorse

One Linux speciality is infusing life into machines doubling up as paperweights because they can't keep up with the hardware demands of modern OSs. While there are many distros that are designed to power older hardware, our all-time favourite is Puppy Linux. The distro uses one of the lightest window managers (*JWM*) and though it might not be pretty to look at, it'll turn that old lethargic work horse into a galloping stallion. But the main reason for Puppy's stellar performance on hardware with limited resources is its sheer number of lightweight custom apps. The distro has graphics apps, productivity apps, apps to playback, edit and even create multimedia. Using its custom apps, you can block web site ads, grab podcasts, do internet telephony, burn optical media, and a lot more. The distro is available in different flavours. The Wary Puppy edition uses an older kernel and includes additional drivers to support peripherals like dial-up modems. There are flavours based on the recent Ubuntu releases too, such as Tahrpup based on Ubuntu 14.04 and Slacko Puppy based on Slackware Linux. These editions use a newer kernel than Wary but take advantage of Puppy's custom apps for limited resources.



apps and documents on the local computer as well as online services. Gnome includes an Online Accounts app that enables you to sign into online services, such as Google Docs and Flickr. In fact, Fedora will ask you to sign into these online services when you boot into the distro for the first time.

The Gnome desktop also has several custom apps of its own that can fetch information and data from the added online accounts. For example, the Gnome Contacts apps can pull in contacts from various online sources, such as Gmail. Similarly, Gnome Documents will help you find documents from online repositories such as Google Docs.

New users should also keep an eye out for the desktop's peculiarities. For one, you won't find the Minimise buttons on any of the windows in Gnome. When you want to switch to another app, head to the Activities Overview and launch a new window or select an existing open one. Another esoteric aspect is the lack of any desktop icons as well as the ability to create any shortcuts or place any folders on the desktop.

However, Gnome's redeeming aspect is its tweakability: you can add new features literally with a single click. Gnome supports a plethora of extensions that you can enable without any installation. Just head to the Gnome Extensions web site (extensions.gnome.org), find the plugin you wish to enable and toggle the button to activate it on your desktop. Some of the popular extensions are designed to help ease the transition for users moving to Gnome from proprietary operating systems, such as Windows.

KICK OFF WITH KDE

Unlike the other two desktops, the layout and behaviour of the KDE desktop and the placement of its Kickoff app launcher will certainly feel

familiar to users from non-Linux operating systems. But KDE is so malleable that many KDE distros look unlike each other. In many ways, KDE is the quintessential Linux desktop with its flexibility and myriad number of options. There's literally no end to KDE's customisation options.

One of the most useful KDE features is Activities. Using this feature, you can create several context-aware activities, each with its own set of apps and desktop furniture. For example, you can create a Social activity that signs you into all your instant messaging accounts and displays updates and feeds from various social networks. Many KDE distros ship with just the default activity, called the Desktop Activity. However, you can fetch more activities from the internet and build on them to suit your workflow.

Furthermore, KDE ships with multiple interfaces or Views designed to make the best of the available desktop real-estate. There are different Views for regular screens and netbook though you can use any View on any type of computer. To switch Views, right-click on the desktop and from the context-menu select the Default Desktop Settings option. In the window that opens up, select the View tab and checkout the different views from the Layout pull-down list.

Many KDE distros place the Folder View widget on the desktop which displays the contents of a folder in a neat little box that you can place anywhere on your screen. Then there's the Folder View which lets you place files and folders anywhere on the

desktop. The Search and launch View is designed for devices with a small screen or a touchscreen. Each View has additional configurable elements.

In addition to bundling the configuration options along with the individual elements, KDE also houses them all under the System Settings panel, alongside other system-wide configuration options to administer the underlying Linux distro. It might seem daunting, but you don't need to set up or review each and every option before using the desktop. Customising KDE is an on-going process and not a one-time affair. The desktop is designed to grow and mutate as per your usage requirements.

31 FLAVOURS

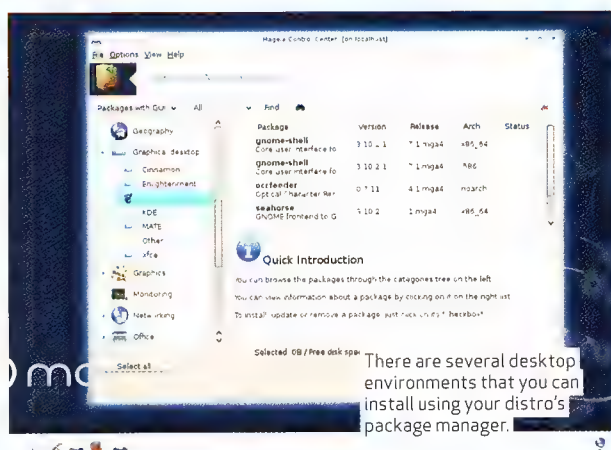
In addition to these three chief desktop environments, there are a lot more that you can put atop your distro. There are fully fledged environments, such as Cinnamon, as well as lightweight ones, such as Xfce, LXDE and Mate. In fact, most mainstream distros, including Ubuntu, Fedora and Mageia are available in multiple editions with different desktops.

For example, the Ubuntu distro has a number of officially supported spins. There's Kubuntu which dresses Ubuntu with KDE as well as a Gnome spin, a Xfce spin and another that uses the Mate desktop. The Fedora distro, which was once known as the premier Gnome distro, now also has a wonderful KDE flavour as well. Similarly, you can also use Mageia with the Gnome desktop as well. In fact, Mageia and Fedora, also have install-only DVD images that give the user the option to install multiple desktops.

"Ubuntu, Fedora and Mageia are available in multiple editions with different desktops."

Switch desktop environments

You can also install multiple desktops on top of your distribution, such as the popular Cinnamon desktop. It's available in the official repositories of Fedora and Mageia and you can install it via their respective graphical package managers. On Ubuntu, it's available via the [ppa:gwendal-lebihan-dev/cinnamon-stable](http://ppa.gwendal-lebihan-dev/cinnamon-stable) PPA. Add this PPA to your system and then install the desktop environment from the Software Center. Once you've installed multiple desktop environments you can easily switch to another one. To do this you just log out of the current desktop environment, and use the login manager and enter your login credentials. Before logging into the desktop, explore the buttons on the login manager. One of the buttons will reveal a drop-down list of all the installed desktops. Select the desktop environment you want to use and the login manager will log you into that desktop. This way you can try them out and choose one you like the best. Choice!



There are several desktop environments that you can install using your distro's package manager.

INSTALL & MANAGE APPS

Flesh out your chosen distribution.

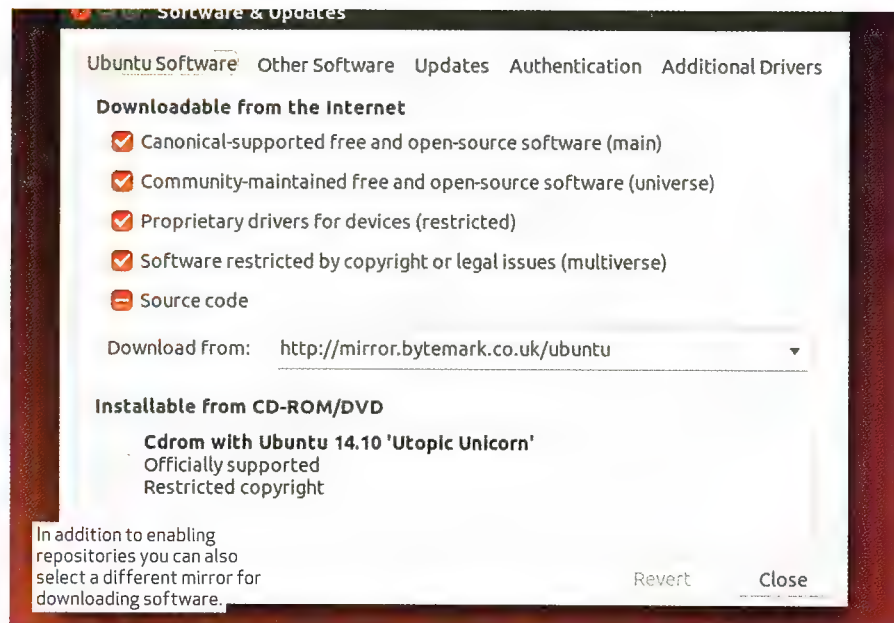
Unlike Windows, a typical Linux desktop distro is more ready-to-use right out of the box. Instead of shipping with basic apps, such as a vanilla text editor or a barebones drawing tool, your average Linux distro will include a fully fledged office suite and a comprehensive graphics editor. This is in addition to the basic set of apps for common tasks, such as browsing the internet, checking email, instant messaging with your friends across various networks, organising photos, listening to music and watching videos.

That said, since we all use our computers differently, you'll likely want a piece of software that isn't included by default. Your distro has specialised tools that'll help you install gazillions of quality open source software without clicking through complex setup wizards.

Linux distros use a collection of software tools, both graphical and command-line based, that are together referred to as a package management system. These tools help you install, remove, and upgrade software (also called packages) with ease. Individual pieces of software are grouped inside packages. In addition to the software itself, packages also include other information, such as a list of other packages or dependencies which are required for the app to function properly. Furthermore, the package management system relies on a database known as the repository to keep track of all the available packages.

PACKAGE MANAGEMENT 101

The Linux world is divided broadly into two different package formats – RPM



and Deb. These are precompiled binary packages that are designed to simplify the installation process. RPM was created by Red Hat Linux, and is used by distros such as Fedora, and Mageia while Deb is used on Debian-based systems, such as Ubuntu. Additionally, almost every major distro maintains its own set of graphical tools to enable desktop users to install, upgrade and remove app. You must also be familiar with the distro's repository structure and how and where it houses software.

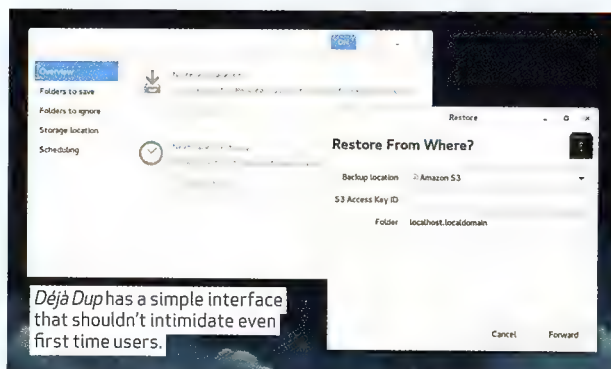
Ubuntu uses the Advanced Packaging Tool or APT package management system. You can use the Software & Updates tool for manipulating Ubuntu's

repositories (or repos). The tool lists repos in four different tabs. By default, the four official repos under the Ubuntu Software tab are enabled. The Main repo includes officially supported software, and the Restricted repo includes software that isn't available under a completely free license. The two interesting repos are Universe and Multiverse repos, which include software maintained by the community and software that isn't free, respectively.

Unlike Ubuntu the Fedora distro uses the RPM package management system. The distro houses repositories under the /etc/yum.repos.d directory and the

A backup primer

Your distro will include a tool to help you backup your data and you should take some time out to get familiar with it. Ubuntu, for instance, ships with the Déjà Dup backup app which is designed for new users. You can also install it on top of Fedora and Mageia. No matter what backup tool you use, you should take a moment to consider what you should backup. Backing up the entire home directory might be convenient but is usually overkill. Instead you should include the directories under your home directory such as Downloads and Documents. Also check with important apps, such as email clients, who keep downloaded emails, attachments and address books under hidden directories (prefixed with a ./) beneath the home folder. Also, keeping the backed up data on another partition of the same disk isn't going to be of much use, since the whole disk might fail. One solution is to keep the backup on another separate disk or external drive. Or, if you have good internet bandwidth, the backup app might also help you store the backups on a cloud storage service.



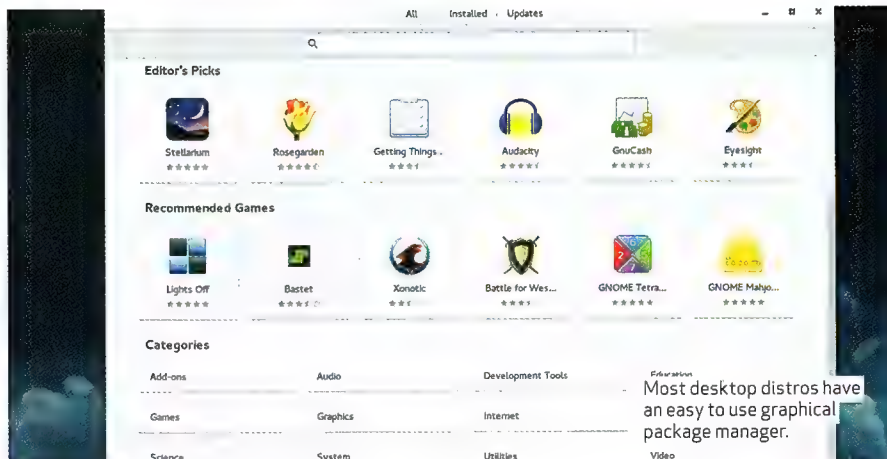
main repository is named `fedora.repo`.

Mageia uses the `urpmi` package which is a wrapper for the RPM package management system. The distro has three official repos. The core repository contains open source packages, the non-free repository contains closed-source apps, and the tainted repository has packages that might infringe on patents and copyright laws in some countries. Each of these repos is further divided into four sub-repos. The release repo includes stable packages, the updates repo includes packages that have been updated since the release, and the backports repo contains packages of new versions backported from the Cauldron repository, which will eventually become the stable repo for the next release. There's also the testing repo which will contain software primary for QA purposes.

To configure repos, launch the Mageia Control Center and head to Software management > Configure media sources for install and update. To install the official online repositories, click on Add and then either on Update sources only or Full set of sources. The first choice is the minimum to keep the distro updated, while the second allows you to install new software. These options will populate the window with a list of repos. Then toggle the Enabled checkbox next to the repo you want to fetch software from.

FEDEX PACKAGES

All major desktop distros include a graphical tool for managing packages. Ubuntu's Software Center is one of the best. You can find software by clicking on the category reflecting the type of software that you're looking for. When you select a category, you will be shown a list of apps. There's also a search box in the upper-right corner of the window which will look for software matching any entered keywords. Once you've found the software you want, click the Install button to its right. This will fetch the software as well as any required dependencies and automatically install



it. All newly installed software is added to the Launcher and you can also find it from under the Dash.

Fedora uses the PackageKit graphical tool that's listed as Software in the Gnome's Activities menu. It too lists software categories as well as a keyword-matching search box at the top to help you find software. Once you've found the software that you're looking for, click on the Install button and the app will add it to your installation.

The graphical package management tool for Mageia is named `Drakrpm`. The tool isn't as pretty as the software centres in Ubuntu and Fedora, but is very functional and intuitive enough to get the job done. You can filter its list of available apps to show only packages with GUI, security updates, bug fix updates, and more. Applications groups are listed in the sidebar and there's also a search box to hunt for packages based on keywords. When you find a package you want, toggle its corresponding checkbox and click on Apply.

THE REPO MEN

The larger open source community offers a lot more packages than the ones listed in your distro's official repos and almost every distro has a mechanism to add and install software from these third-party repos.

External repos in Ubuntu are known as a Personal Package Archive or PPA. You can add a PPA repo to your distro using the Software & Updates tool. But first you need the address of the PPA. This is listed on the PPA's Launchpad site and will be something like `ppa:example-ppa/example`. Now fire up the tool and switch to the Other Software tab. Then click on the Add button and paste the address of the PPA in the window that opens. Ubuntu will then ask you to refresh the repos to enable the PPA.

Similarly, Mageia has a number of third-party repos as well and you'll need their URL to add them to your distro. Once you have the URL, fire up the Mageia Control Center and head to Software management > Configure media sources for install and update and click on the Add a medium option. Enter the address of the repo in the window that pops up along with its type such as HTTP or FTP.

Fedora also has a number of third-party software repos but the most popular is RPMFusion. The repo is further sub-divided into two independent repos that house free and non-free software. You can install both of these repos from within the browser itself by following the instructions on the repos web site (www.rpmfusion.org/configuration).

Grabbing Google

All popular Google software, such as Chrome, Earth, the audio and video plugin for Hangouts and others can be installed on Linux. But you won't find them in the official repos of major distros because of their licensing. However, you now have all the know-how to install them with ease if we point you in the right direction. The downloads page of each supported Google app contains links to both 32-bit and 64-bit versions of the software in both RPM and Deb formats. Download the package for your particular distro and double-click on the file to install it with the distro's package manager. All official packages for Google apps will also install the appropriate external Google repository in your distribution to keep the software updated. Another popular

proprietary software that you may want to install is Skype. Ubuntu users can simply enable Partner Repositories by visiting Software & Updates > Other Software. This will add the official Skype repos and you can then install the software from the Software Center as for any other software package. Mageia, on the other hand, includes the Skype package in its non-free repo. If you've enabled this repo, then simply search for the `get-skype` package which will download Skype from its web site. You can also head to the Linux download page on Skype's website and choose your distro and architecture from the pull-down list which will download either a Deb file or an RPM file. Double-click on the file to install it with the distro's package manager.

PLAY MULTIMEDIA

Turn your distro into the ultimate media centre.

Most Linux distros designed for desktop users are capable of handling all types of content you throw at them. But some content, especially most audio and video, is distributed in closed formats that are encumbered by patents. The distros can't play these files straight out of the box, however, most have clearly outlined procedures to allow users to install components to play these popular non-free media formats.

Ubuntu gives you the option to install the components that can play files in restricted formats, such as MP3s, during the installation itself. If you've already installed the distro, you should then use the package manager to install the ubuntu-restricted-extras package, which includes popular proprietary codecs and plugins.

On Fedora these codecs are bundled in the third-party RPM Fusion repository. You'll have to first enable the repo as mentioned earlier and then fire up a terminal and enter the following commands to fetch the codecs:

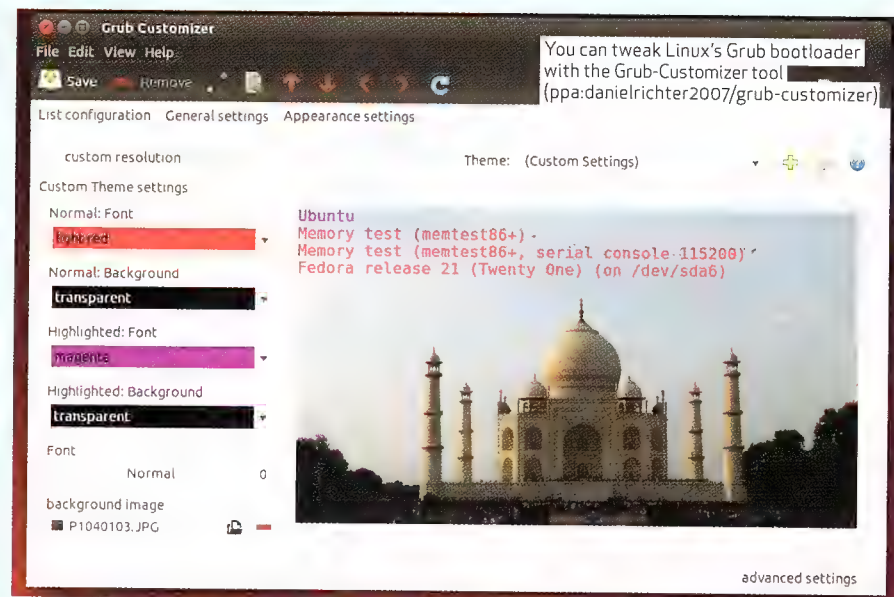
```
su -
yum install gstreamer{,,-}
{plugin-
crystalhd,ffmpeg,plugins-
{good,ugly,bad{,-free,-
nonfree,-freeworld,-extras}
{-extras}} ffmpeg libmpg123
lame-libs
```

If you're using Mageia, you'll find the multimedia codecs under the Tainted repository, so make sure you enable it following the procedure mentioned earlier. Then launch the Welcome app from under the Tools menu and switch to the Applications tabs. From here you can install several useful and popular packages including multimedia codecs.

WHERE'S THE BLING?

Despite the rise of the open source WebM format, many web sites still require Adobe's Flash plugin to properly stream multimedia content. Getting the Flash plugin on Linux is tricky since Adobe is no longer developing Flash for Firefox on Linux. The only way to use the latest Adobe Flash plugin on Linux is to use Google's Chrome browser which includes the Pepper-based Flash plug-in.

That said, if you don't want to switch to Chrome you can still install the out-of-date Flash plugin and continue using the Firefox browser. Or, you can extract the newer Pepper-based Flash



plugin from the Chrome browser and use it on Chrome's open source cousin, the Chromium browser.

Ubuntu users can install Flash for Firefox with the

```
sudo apt-get install
flashplugin-installer
```

command. If you're using Chromium, you can use the latest Pepper Flash plugin by installing the pepperflashplugin-nonfree package.

Fedora users can download the Firefox plugin from Adobe's web site by adding its repo. If you are running a 64-bit installation, this command:

```
yum -y install http://
linuxdownload.adobe.com/
adobe-release/adobe-
release-x86_64-1.0-1.noarch.
rpm
```

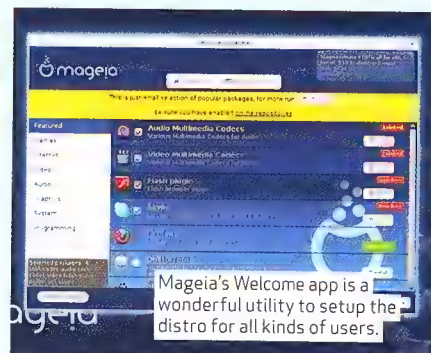
will download and install the correct repo. You can then import the key for the repo with:

```
rpm --import /etc/pki/rpm-
gpg/RPM-GPG-KEY-adobe-linux
```

before installing the plugin with:

```
yum -y install flash-plugin
```

Mageia users can simply enable the nonfree repository which houses the Flash plugin and then install it from the Applications tab in the Welcome app.



BEST MULTIMEDIA APPS

Most distros ship with audio and video players. The popular ones are Rhythmbox which is the default on Gnome-based distros and is well integrated in Ubuntu, and KDE's default Amarok. In addition to local tracks, both players can also stream internet radio and podcasts. If you want more attractive looking players, fire up the package manager and look for Banshee and Clementine.

Similarly, the default video player on most Gnome-based distros is Totem (now simply called Videos). If you want something with more feature you can grab MPlayer. This is essentially a command-line media player but it has a number of frontends. Gnome users can use Gnome-Mplayer and KDE users can use KMPPlayer. There's also the popular cross-platform VLC that can handle pretty much any file format.

Play games

Full steam ahead!

Gaming has long been considered Linux's Achilles's heel. Over the years we've had several quality open source games, but they've lacked the mass-appeal of popular gaming titles available on proprietary desktops. All that changed in early 2013 with Valve's announcement of Steam for Linux client for its hugely popular game distribution service.

You can install the proprietary client in your distro with ease. Ubuntu users should enable the Partner repo and then install the client from the Software Center. Fedora users should install the RPM Fusion repos and then install Steam using the package manager. Similarly, Mageia users should enable the non-free repo and then use the Mageia Welcome app to install the Steam client.

But before you fire up the Steam client make sure you've got the proper drivers for your graphics hardware. This tends to be the major sticking point for users, as card manufacturers restrict distribution of their closed-source driver elements. Start by getting details about the make and model of your graphics card using the

```
lspci | grep VGA
```

command. You can get more details, such as its clock speed and capabilities, with:

```
sudo lshw -C video
```

Your distro will ensure you are using the most suitable open source driver as



soon as you boot into the distro. The Oibaf PPA (ppa:oibaf/graphics-drivers) is popular with Ubuntu users for getting the latest bleeding edge open source drivers. However, users of Nvidia and ATI/AMD hardware should use proprietary drivers from the respective vendor for the best gaming performance.

Ubuntu users should use the X-Swat PPA (ppa:ubuntu-x-swat/x-updates) for the latest stable Nvidia drivers. Once enabled fetch the drivers with:

```
sudo apt-get install nvidia-current
```

Fedora users will find the latest GeForce drivers in the RPM Fusion repo. After adding the repo, install the driver with

```
yum install kmod-nvidia  
xorg-x11-drv-nvidia-libs  
kernel-devel acpid
```

Mageia users should first enable the non-free repo and then launch the Mageia Control Center and head to Hardware > Set up the graphical server. In the window that open click on the toggle next to the Graphic Card label which will display a list of graphics card. Browse the list and select yours. If Mageia has a proprietary driver for the card, it'll install it.

Mageia's list also includes AMD cards, but if you are using Ubuntu or Fedora, the best source for the proprietary driver is AMD's web site (support.amd.com/en-us/download). This page has several dropdown menus that you can use to pinpoint the exact driver for your graphics card. Then download the suggested driver and extract it to reveal a .run script. Before you install the driver make sure you install its dependencies with:

```
sudo apt-get install dh-make  
dh-modaliases execstack  
libc6-i386 libc6-gcc
```

Once that's done, you can execute the script with:

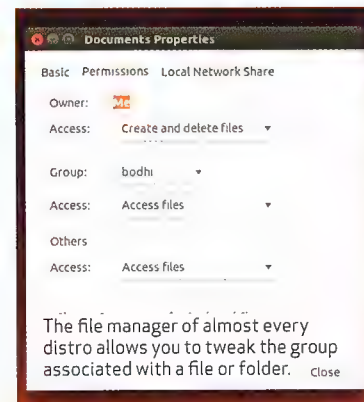
```
sh ./amd-driver-installer-  
13.35.1005-x86_x86_64.run
```

This will launch the graphical AMD Catalyst proprietary driver installer and will also install the Catalyst Control Center GPU management software. When the installer has finished, head back to the terminal and enter

```
/usr/bin/aticonfig --initial  
to configure the driver.
```

User admin basics

When Linux is installed, it's automatically configured for use by a single user, but you can easily add separate user accounts. The superuser, root, has complete access to the OS and its configuration; it's intended for administrative use only. Unprivileged users can use the su and sudo programs for controlled privilege escalation. Users are grouped together into a group, and inherit the group's access privileges. Every Linux user is a member of at least one group. Now, you can control which files and folders are accessible by a user or a group. By default, a user's files are only accessible by that user, and system files are only accessible by the root user. In Linux files and folders can be set up so that only specific users can view, modify, or run them. This allows you, for instance, to share a file with other users so they can read the file but not make any changes. Access to files is controlled via a system of ownership permissions. You can use the ls -l to list the permissions. When used without specifying a filename it will list the permissions of all files within the directory. The different characters in the output represent a file's read (r), write (w), and execute (x) permissions for the owner, group, and all other users. You can alter the permissions of files and folders with the chmod command or graphically from the file manager. ■



howto

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

OFFICE APPS

AVOIDING CLICHES LIKE THE PLAGUE

Is there an easy way to get a count of my most frequently used words in a Word document? I don't really want to run a separate program, but at a pinch I guess I could go with something I could type into the command prompt. I definitely don't want to go down the road of anything involving an Excel spreadsheet.

Adrian de Vries

As you'll have noticed, by itself Word will only count the instances of a single word you search for, but there is a template add-in available to download at tinyurl.com/mwvztku that will add this feature for you. Doing the same thing in the command line is one of those code-golf exercises that is very popular for Linux users, but the Windows command shell isn't really powerful enough to support this sort of shenanigans. Which is fine by me, because exporting your whole Word

file as a plain text document and then typing in a 200-character grep expression is not my idea of convenient. A much better ad-hoc option would be to just copy and paste your entire document into www.wordcounter.com and let that parse the word frequencies for you. The tool at www.writewords.org.uk will also count commonly used phrases.

Personally, I don't find this sort of numerical analysis terribly useful. If your goal is to improve your writing style, try reading what you've written out loud instead. You'd be surprised by how quickly overused words and phrases jump out at you that way.

Luis Villazon

HARDWARE

SWITCHING CPUs

I recently purchased a high-end PC including an Intel Core i7-4770K chip. As this \$2,600 rig was being assembled, the Core i7-4790K became available at the same price. From what I understood from

the PC shop, the upgraded CPU came out too late for them to swap it. Can you tell me if there's a way to swap CPUs without having to reinstall the OS? Or is it possible to safely overclock the 4770K to 4GHz without damaging the chip? And how would I do this? As I understand from one of your articles, the 4790K is essentially a factory-tweaked 4770K.

Guy

To answer your first question, you can upgrade or install a different CPU without having to reinstall your operating system. In general, as long as you're not changing the motherboard, an upgrade is as simple as removing the CPU cooler and dropping in the new chip (after applying a new coat of thermal paste, obviously). However, because going from one chip to the next in the same socket usually results in a very small and unnoticeable performance increase, we don't recommend it. You usually need to wait at least two generations for an upgrade in order to achieve noticeable improvements, so for example if you went from 2011's Sandy Bridge to 2012's Ivy Bridge you wouldn't see much improvement. However, if you were to upgrade from an older 2009 Nehalem CPU to 2013's Haswell, you'd be stunned at how fast it feels (at least at first, before you adjusted to that newfound horsepower). That said, you can upgrade to the Core i7-4790K, but the delta between it and the 4770K would be so small that it's not worth your time or money. That 4770K should last you at least a few years, so it won't be until Skylake and beyond that you should even think about your next upgrade. As far as overclocking goes, yes, you should be able to get that CPU up to 4GHz very easily in its Turbo Boost mode. Most of the 22nm Intel parts can reach 4.2GHz or so just by fiddling with the BIOS, and since it's a K-part, it's already "unlocked," so it should be quite easy. How you actually overclock it varies according to your motherboard model, so use Google to find one to help you out with that. You

WORDCOUNTER

Wordcounter ranks the most frequently used words in any given body of text. Use this to see what words you overuse (is everything a "solution" for you?) or maybe just to find some keywords from a document.

Wordcounter is useful for writers, editors, students, and anyone who thinks that they might be speaking redundantly or repetitively -- and it's free! Eventually, I'm going to expand it so that you can upload documents, but not yet.

Enter the body of text here (to count & rank the word frequency):

Include Small Words ("the", "it", etc)? ☐ No -- exclude them

Use Only Roots (group variations together)? ☐ Yes (beta)

How Many Words should I list?

Go >>

If you enjoy the Wordcounter, you might enjoy my new web page, [Spanish for Nerds: Learn Spanish via Etymologies](#) - it's a weird cool method I use to learn Spanish!

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You can find numerous free tools online that can check your documents for over-used phrases.



Upgrading from one Core i7 to its immediate successor won't reap big performance gains.

shouldn't need extravagant cooling either, so a simple and efficient CPU cooler such as the Cooler Master Hyper 212 should be sufficient. APC team

HARDWARE

BUSTED FROZR

I've got an aging Nvidia GTX 570 card from MSI that came with a Twin Frozr II cooler. While considering the possibility of either an upgrade or SLI configuration, I noticed the temperatures on my GPU were getting very high according to the monitoring software I use, especially under load. After investigating, I discovered one of the fans on my card had completely seized up while the other stuttered and barely ran at all. I've since removed and cleaned the card, disassembled the Twin Frozr II assembly to gain access to the fans' rear area in an attempt to perform a lube, and reinstalled everything. After all that I discovered I'd completely failed to coax either fan back to life. I now have a quasi-serviceable video card that lacks a working cooler (I found one option to buy a replacement fan bundle, but it's sourced in China and comes with hefty import fees). As things stand, anything more taxing than short streaming videos pushes temps up to and beyond 90°C. My rig has been hobbled. I'm now seeing phantom longevity issues with heatsink/fan combination coolers wherever I look. I'm needing some reassurances that if I buy a new card today, I won't end up in the same situation a few years down the road. Also, an explanation as to why no one seems to offer an off-the-shelf water cooling solution for GPUs would be good. Brandon Kalaskie

Our main advice is to examine the manufacturer's warranty before purchase. For video cards, warranties typically range from three to five years, which should be sufficient given how fast technology advances, but we

realize some people aren't always able to upgrade. If your product fails once it's past that warranty period, well, there's not much you can do. Many of us actually look forward to such a failure, as it gives us a spouse-proof excuse to upgrade. For your case, there are aftermarket solutions both in the air and water realms. For air coolers there are a ton of options that fall under the Google phrase "VGA cooling." Arctic Cooling is the most prolific, as it's been making add-on coolers for GPUs for as long as we can remember. The primary consideration for these coolers is to make sure they're able to cool the onboard components and memory of the card, as they can get just as hot as the GPU at full load. Most coolers have heatsinks you can apply to the memory modules and an airflow pattern that washes over the rest of the components, but make sure you're not ignoring the overall board temps in favour of just monitoring your GPU temp. Also, our Google Fu shows us the Zalman VF3000 is specifically designed for your GTX 570 card, and there are a few of them on eBay.

On the liquid cooling front you have a few options. First NZXT makes a GPU cooling system called the Kraken G10 that's compatible with the GTX 570 and costs \$40. You still need to bring your own closed-loop liquid cooler (CLC), but it'll work with a variety listed on the product page: tinyurl.com/1vw6j9. Its thermal coverage isn't as good as a block designed for custom liquid cooling, but going that route would cost as much as simply replacing the card. You'll need a fan mount inside your case for the G10's CLC, too, so make

sure your case can accommodate this. Corsair has also recently released a liquid cooling solution for GPUs named the HG10. It also requires you purchase a separate Hydro Series liquid CPU cooler, just like with the NZXT.

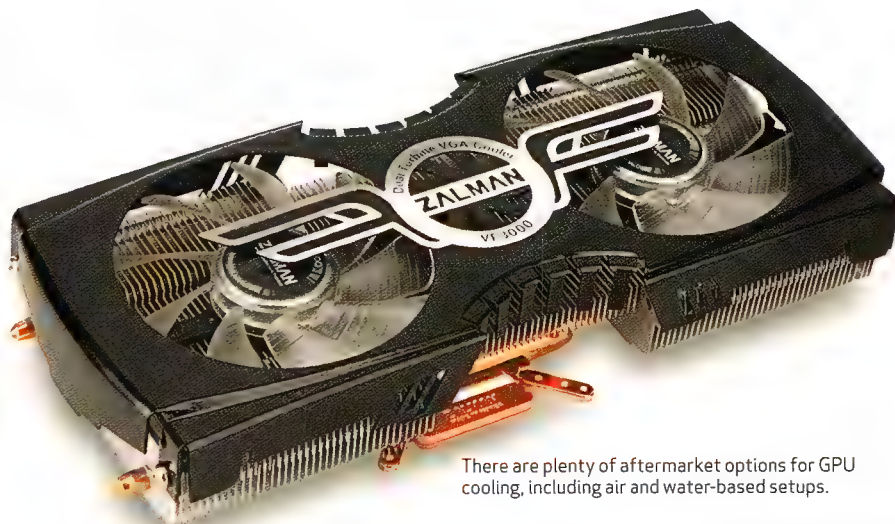
WINDOWS

SUPER SLOW

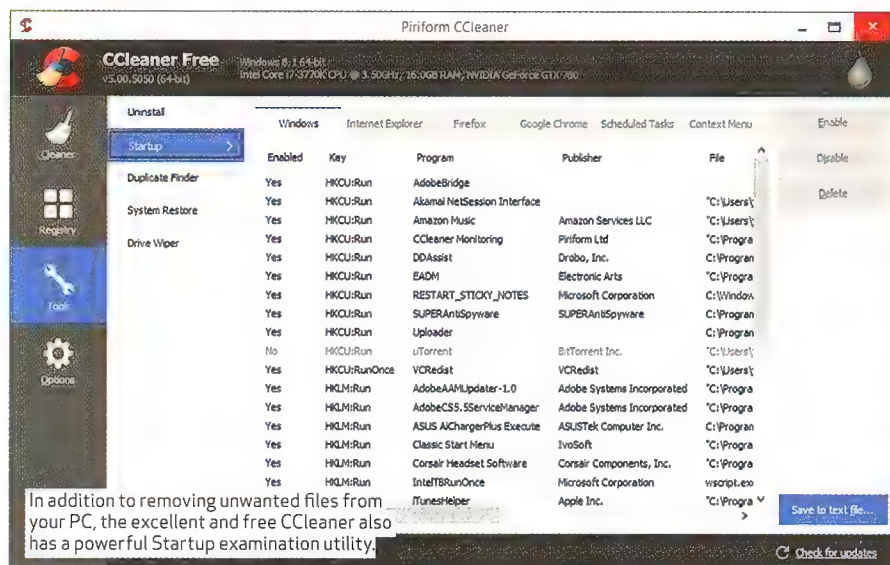
Hey APC, I hope you can give me some direction on this. So, my parents bought a new Dell PC about four years ago. It's running Windows 7, has 6GB of RAM, a 1TB hard drive, a graphics card (not sure which one), and most of all an AMD Phenom X6 CPU at 3GHz. It was a great deal when my dad found it, and for what they do, I thought it would be perfect!

I thought the Phenom X6 would be blazing fast. My mum mostly surfs the net and does some light picture editing. Well, a little while after they got it, my mum complained about how slow it seemed, so I went over there one weekend and attempted to use their PC. It took over five minutes to see the start of the desktop and another five minutes before I could click on anything. Then Internet Explorer kept freezing on me. The hard drive is only 15% full, so I know a full drive isn't the problem. I bet there is some bloatware that could be removed, but it just seems so slow that there has to be something else going on. Any recommendations on where to start? Do you think maybe the hard drive is just that slow? I mentioned an SSD to them and reinstalling the OS, but they're not sure they want to do that unless it's the only way. Any help would be wonderful. Jarod Myrick

First off Jarod, we're positive many people reading this are feeling PTSD



There are plenty of aftermarket options for GPU cooling, including air and water-based setups.



symptoms from having to fix a slow PC for relatives. It's probably the most common ailment for your garden variety rig out there in the wild — PCs full of bloatware, viruses, toolbars, multiple antivirus programs, and worse. Seeing those PCs in such a sorry state always broke our hearts. The good news is we have some baseline tactics.

First, comb through the 'Programs and Features' menu in the Control Panel and remove any program not being used. Sometimes Malware likes to hide in plain sight. Next take a look at what's starting automatically by typing `msconfig` into the search box in the Windows Start menu. This will display services and programs that start automatically every time your PC boots. You'll want to check the box labelled "Hide all Microsoft services" before purging, but once those are cleared just examine the list and use your judgement. You probably need your antivirus or fan control service to start automatically, but not an app that checks for updates on a piece of software you give zero effs about. When it comes to the Startup tab, this is where you'll see a real difference in boot times and overall readiness after boot. Be careful here, but keep in mind that whatever you uncheck can always be rechecked if a problem arises. We also recommend downloading and installing the excellent free utility CCleaner (www.piriform.com), as it can quickly and easily remove excess files. As a bonus it also has a built-in 'Startup utility' that is much more extensive than the one included with Windows. It can be found under the Tools menu.

With those basics out of the way, we gotta say your parents' PC sounds like it has an old skool virus or malware infestation. We recommend starting off with Malwarebytes, which is free and great at ferreting out malware.

Next scan with SuperAntiSpyware, which is also free and generally excellent. For a virus scan, instead of going to the store (virtual or brick), just run a browser-based scan like the one available from BitDefender. It's free, fast, and can help. If you do all of the above you should see an improvement. For boot times, we would normally expect a Windows 7-based "mum and dad" rig to boot in about a minute with a hard drive running the show. Installing an SSD could drop that to 30 seconds or so, but not even an SSD can overcome a total system infestation. Our advice is to clean the system, then install an SSD to help keep the system running at breakneck speed so you don't have to go over there anymore just to fix their PC.

WINDOWS

HOW DO I FILL MY HARD DISK?

I bought myself a hard disk upgrade last week, to keep my trusty desktop gaming rig trucking along for another few years. It's a 7,200rpm 3TB Seagate drive, which has more than enough capacity for my needs. The trouble is, I can't get Windows 7 to recognise more than 2TB of this capacity. As I say, I have plenty of space, but it seems like a bit of a waste to only use two-thirds of the drive's capacity. I'll be upgrading to Windows 8 soon anyway (just as soon as I've upgraded the video card). Will this get around the problem?

Peter Gradlestone

Probably not. The 2TB limit applies to the MBR (Master Boot Record) used by the 32-bit versions of Windows 7 and Vista. MBR is a disk partitioning scheme that uses 32-bit integers to hold the block numbers for files on the disk. Since a block is 512 bytes, that gives a maximum partition size of $2^{32} \times 512$, which is 2TB or 2.2TB, depending on whether you're using binary or decimal terabytes.



If you're running an older 32-bit version of Windows, you won't be able to take advantage of hard drives over 2TB.

Partitioning the disk into a 2TB and a 1TB partition won't help because Windows won't be able to hold a big enough number to handle the start block of the second partition. If this all seems depressingly familiar to older readers, it's because we went through more or less the same problem back at the start of the noughties, with the 28-bit sector addresses used by the ATA protocol that limited partition sizes to 137GB. And before that we had the 8.5GB limit due to the INT 13h interface in the BIOS. And so on back to the dawn of computing when the original hardware designers couldn't imagine any circumstance where someone would want to store both a one and a zero at the same time.

Upgrading to Windows 8 (or Windows 7 64-bit) is part of the solution here, because these operating systems both support GPT. This stands for 'GUID partition table'. GUID stands for 'globally unique ID'. ID stands for identifier. GPT is the replacement to MBR and supports disk partitions up to 9.2 zettabytes. This is approximately 10 times the size of all the traffic across the entire internet last year, so we'll probably outgrow this limit in about five years. In the meantime, GPT also requires a motherboard that supports UEFI, so if your motherboard hasn't been upgraded in the last few years, you are probably still stuck. Except that you aren't really, because there's really no difference between partitioned disk space that you never use and unpartitioned disk space. If you don't need more than 2TB, you can leave the rest of that space unallocated for now and wait until the rest of your PC catches up to make use of it.

Luis Villazon



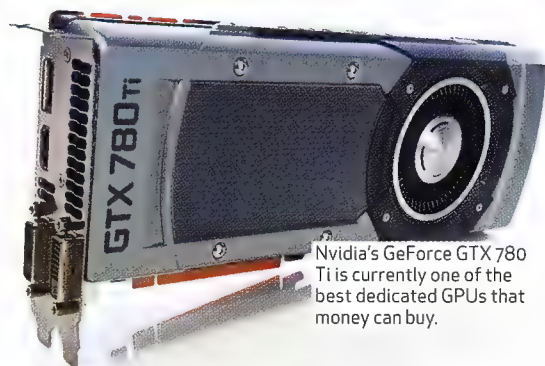
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TECHNOLOGY, TESTED

Overclock your GPU in Windows

Matt Henson shows you how to get more performance from your graphics card.



Nvidia's GeForce GTX 780 Ti is currently one of the best dedicated GPUs that money can buy.

There comes a time when however powerful your graphics card is, the latest games will stutter with all the visual settings cranked up to Ultra. But that doesn't necessarily mean you need to buy a new GPU. By overclocking your graphics card you can make it work harder, without spending any cash. Of course, as with overclocking processors, there are caveats. We don't want to scare you off — for the most part, overclocking is safe and easy — but you should know the risks. You'll be pushing your card to its limits, and there's a slight chance things could go wrong. You should also check your GPU's warranty, because overclocking might invalidate it. Also keep your expectations in check. You should see improvements straight away, but if there's a game your graphics card is really struggling with, an overclock won't suddenly make it playable. If that's the case, you may still have to look at upgrading your GPU.

1 DO YOUR RESEARCH

A little reading at the start will save you time later, plus make sure your overclock is built on a sturdy foundation, so look up your graphics card. Type your card's model, make, and manufacturer into a search engine to see how other overclockers have fared (web sites such as www.overclock.net have active forums). But only use their results as a rough guide. Don't assume you can just apply the same settings — your GPU might not be exactly the same, even if it seems so on paper. Applying a big leap in clock speeds is not advisable either, because putting in the wrong values could damage your hardware.

2 GET TOOLED UP

Overclocking can be time-consuming, but there's a number of things that make the task easier than overclocking a processor. To begin with, the procedure is done using tools within Windows, rather than the BIOS, so you don't have to keep rebooting your machine. The various tools we're using to overclock the system are also

more user-friendly.

- First, visit your card manufacturer's web site (for Nvidia, see www.nvidia.com and click on "Drivers," for AMD, visit support.amd.com). Check your drivers are up to date.
- Next, visit unigine.com/products/heaven to download Heaven Benchmark. This is what you'll use to check your overclock is stable. Run Heaven and save the results before you start overclocking, so that a comparison can be made later.
- Finally, download and install the overclocking and testing tools for seeing the benefits of the overclock and making sure it can perform under pressure. Here are three good options — the interfaces are largely similar, so it's mainly a personal choice.
- ASUS GPU Tweak (Image A) comes with ASUS GPUs or can be downloaded from tinyurl.com/414asustweak. When you run Tweak, you'll see a window with several sliders to apply to your overclock. On the right-hand side you'll see GPU-Z Incorporated, a handy tool for getting information about your card.
- Zotac Firestorm comes with Zotac GPUs or can be downloaded from www.zotac.com/z-zone/zotac-firestorm.html. It has a more understated design and you get a

single window with a number of tabs. Clicking Clocks takes you to the overclocking section, which uses sliders to increase values (Image B). Click Monitoring for temperature, fan speeds, and more.

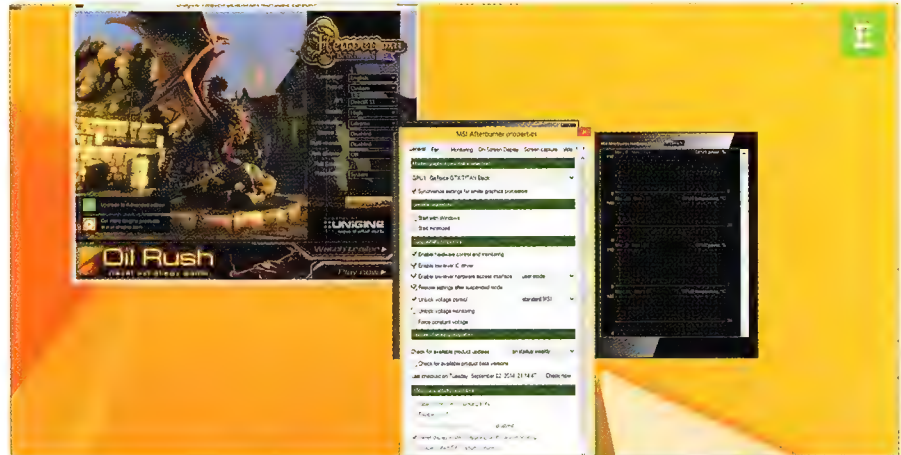
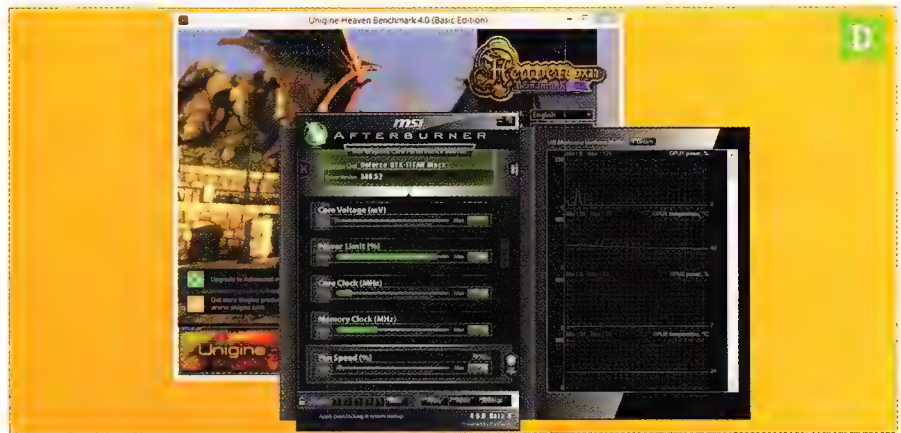
- Perhaps most popular is MSI Afterburner, which comes with MSI cards or at event.msi.com/vga/afterburner. This is the one we're using, but you can apply the same settings in the other overclocking tools if you have those instead.



3 START THE OVERCLOCK

Begin by running Afterburner. On the first screen you'll see an overview of your card, and sliders that can be used to overclock it (Image C). On the right you'll see graphs that show the temperature and power levels of your card. Keep a close eye on these to make sure they remain safe.

- The best way to overclock is to increase by small increments, then test the stability. Go to the Core Clock (MHz) slider and up it by 10MHz. Once done, click Apply. See if the overclock is successful by using GPU-Z (downloaded from www.techpowerup.com/gpuz) and checking the Clock entry.
- To ensure your overclock is stable, run the Heaven Benchmark (Image D). This puts your card through several intensive tests. At the main welcome screen, set Tessellation to Extreme and Antialiasing to "x8," then click Run. Press F9 to actually start the benchmark. If it completes without any problems, your overclock is stable and you can repeat the process again.
- Return to Afterburner and raise the core clock speed by another 10MHz, then check GPU-Z. If all's well, run Heaven Benchmark. If it's OK, repeat until you see an error, then return to the last stable value. A slightly riskier alternative, when your card falters, is to up the voltage. Simply click Settings in Afterburner and tick "Unlock voltage control" (Image E). Move the slider up 10mV and run the benchmark. If it's stable, increase again. Make sure the temperature hits no more than 90°C.



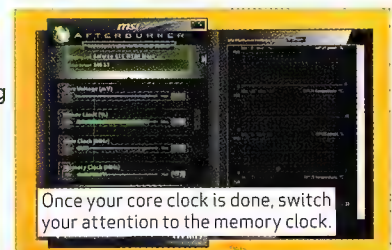
Increase the memory clock

Once you've figured out how high you can push your GPU's core clock, you can do the same with the memory clock to eke out some more performance. The good news is that if you've gone through the process of overclocking the core clock, you know the drill.

Move the slider to increase the value by 10MHz and then click Apply. Now, run Heaven Benchmark again and make sure no errors occur. Don't worry if the benchmark stutters — its aim is to really put your GPU through its paces, so it's doing its job. If the benchmark completes OK, return to Afterburner and increase the memory clock value by 10MHz again. Keep doing this until the overclock is unstable. When it is, dial the memory clock back to the last stable value. You'll now have your

maximum overclock, and you can begin really stress testing your machine to make sure this overclock is stable.

If your PC behaves erratically, don't worry. Simply click the Reset button on Afterburner to return all the values to normal. The overclock is only applied when you run Afterburner, so you can start it up before playing games. If you want it to run automatically, place a tick next to "Apply overclocking at system startup."





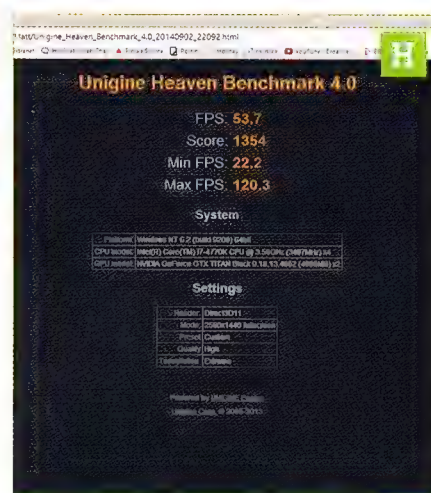
4 STRESS TESTS

It's vital you put your overclock through its paces, so fire up Heaven Benchmark again (Image F). This time, however, don't start the benchmark option. Just let it continue running – the longer you leave it, the more certain you can be that your system is stable. We recommend at least four hours. You don't need to sit glued to your monitor, but look out for artefacts and errors. If your PC is OK after that, you can be confident about your overclock.

While using Afterburner, you may have noticed a grayed-out K on the left. This links to MSI Kombuster (Image G), a tool for stress testing your overclocked GPU. To download and install the program, head to tinyurl.com/414msi; then the K icon in Afterburner will be highlighted. This program has a number of heavy-duty benchmarks, which really push your GPU and its overclock. If it survives these, it

bodes well.

- Run Heaven again and save the results (they're saved as an HTML file). Open them up and compare them to the results you saved from the test you ran before you started overclocking (Image H). You can see the benefits the overclock has provided, including a higher score and higher fps. Another good benchmark is 3DMark (www.3dmark.com). Some games come with their own benchmark utilities as well.
- Now comes the fun part (Image I), remember that the point of overclocking your graphics card is to get improved performance in games. Load up your favourite games and have a play. Hopefully, you should notice frame rates are a lot smoother. You may even be able to increase the graphics settings. Download Fraps from www.fraps.com to see how your frame rates are performing.



Keep things cool

When overclocking your graphics card, it produces more heat than when running at stock speeds, so you must make sure it doesn't overheat. Keeping the mass of wires and cables under control works wonders for airflow, which is essential for keeping the components cool.

Many PC cases enable you to route your cables and wires behind the motherboard, giving your components room to breathe. Speaking of cases, yours should be a decent size, because small cases can get too hot when overclocking. Graphics cards usually come with their own fans and heatsinks. These are fine for stock speeds and even overclocking, but if you're going to be doing some heavy-duty overclocking, video editing, and gaming, you may want to buy some aftermarket coolers for your GPU.

Alternatively, you can incorporate a liquid cooling system to keep your processor and GPU cool.



Enter dates using the Date Pick control in Excel

Helen Bradley shows you how to use the custom Date Pick control in Excel.

When you need to simplify date entry in Excel you can make use of the Custom Date Picker control which is shipped with Windows. This control lets you pick a date from a mini calendar and enter it into a worksheet cell. We'll show you how to configure and use this control.

Open your worksheet and click 'Developer tab > Visual Basic' to launch the VB Editor. Select your worksheet in VBA Project list and choose 'Insert > UserForm' to create a form. To add the Date Picker control choose 'Tools > Additional Controls' and scroll to locate and select the Microsoft Date and Time Picker Control 6.0 and click OK. The control will appear at the foot of the Tools list so click and add it to the form. This control is available for 32-bit versions of Office only.

Add two CommandButton controls and set their captions to read: Enter Date in Cell, and Quit. Set the form's caption to Choose Date. Click on the date control and set the Format property to 3dtpCustom. Set the CustomFormat property to dd MMM, yyyy. Click the Quit button and set its Cancel property to True. Add a label and set its caption to read: Click to select a cell, select a date and enter it.

Double click the first CommandButton and enter this code for its click event:

```
ActiveCell.Value =  
Format(DTPicker1.Value, "dd-  
mmm-yyyy")
```

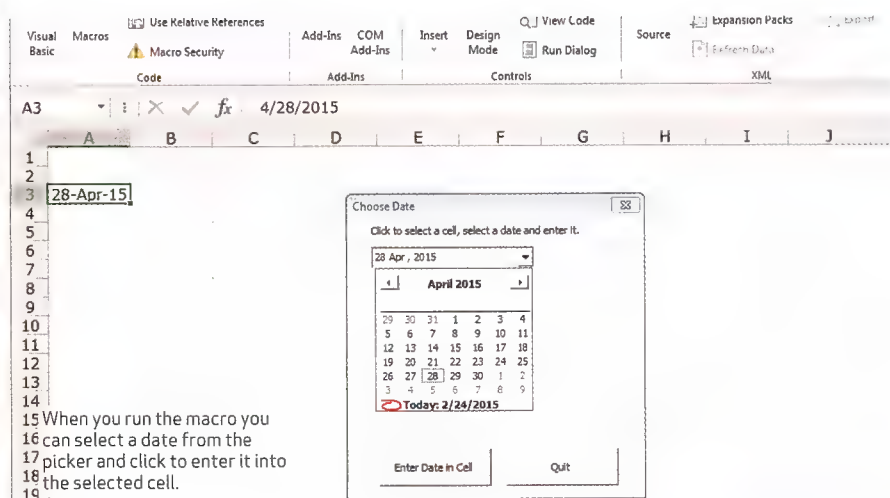
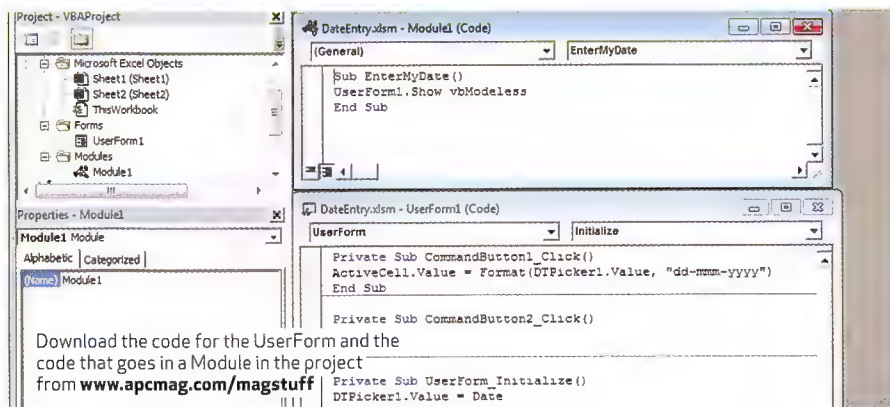
This code inserts the chosen date into the current active cell and it formats it to look like: 12-Mar-2015. You can change the format code if desired to format the date as you want it to appear.

Double click the Quit button and type this code in the click event:

Unload me

Type this code to run when the UserForm loads – it presets the date in the date picker to the current date:

```
Private Sub UserForm_  
Initialize()
```



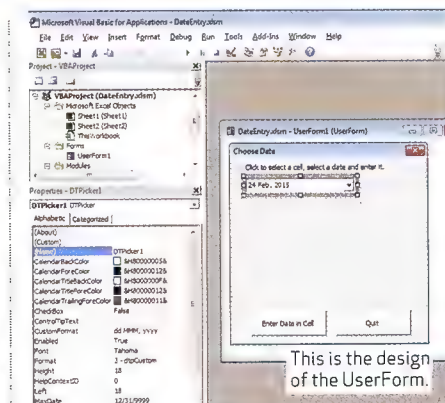
```
DTPicker1.Value = Date  
End Sub
```

Next choose 'Insert > Module' to add a new module and type this code into it:

```
Sub EnterMyDate()  
UserForm1.Show vbModeless  
End Sub
```

You are now ready to save the workbook as an .xlsm file and test it. To do this, run the macro EnterMyDate which displays the UserForm as a modeless form. This means that the form will stay open while you work and will only close when you click its Quit button.

You can now click in a cell and select a date from the date picker. Once the date is selected you can click the Enter



Date in Cell button to enter that date into the currently selected cell. If more than one cell is selected the date is only added to the active cell. ■

When good Macs go weird

When your Mac doesn't "just work" it can be annoying, but Matthew JC. Powell can show you how to fix the strangeness.

Macs, like all computers, are phenomenally complex creations. Millions of variables in trillions of possible combinations in a balletic interplay of ones and zeroes which – mostly – work together quite nicely. But not always. Sometimes, something somewhere will go a little wrong, and that will result in something else going wrong, and in the end things just aren't quite right. Applications crash or won't launch, the CPU randomly maxes out when hardly anything is running, the fans run constantly – all for no apparent reason.

If you ever wondered why the classic troubleshooting 101 instruction is "turn it off and then on again," that's why – actually understanding what caused things to go wrong is bewildering and mostly unnecessary. For the most part, restarting the machine is a better use of your time than figuring out a fault.

But what if restarting doesn't fix whatever the strange behaviour was? That's when you need a few tricks up your sleeve.

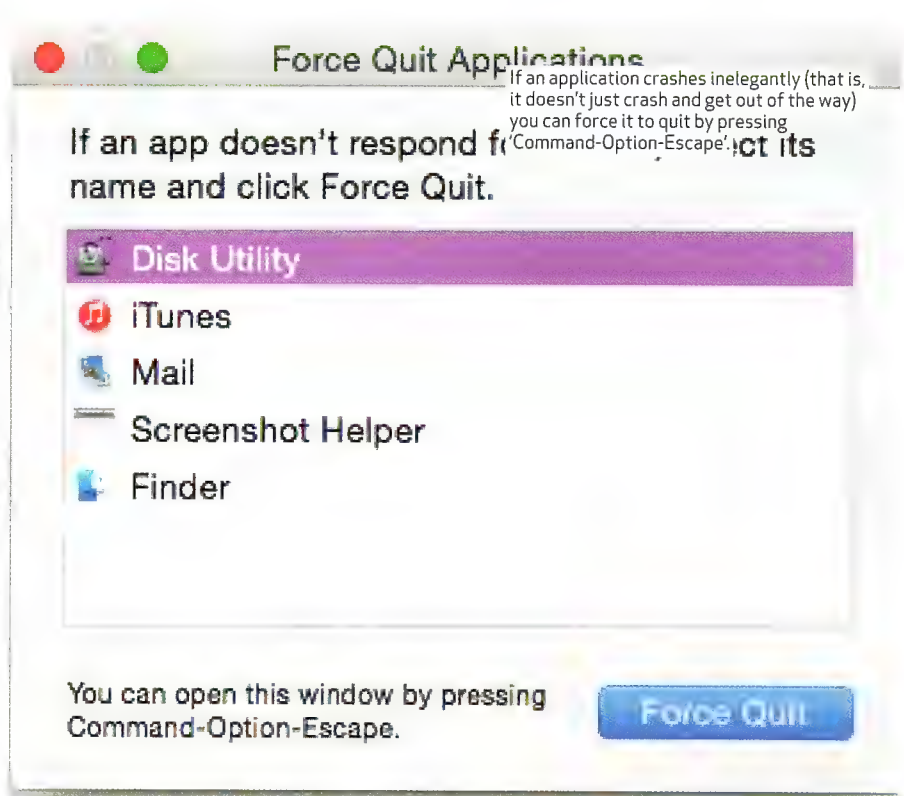
FIRST REPAIR PERMISSIONS

This may seem counterintuitive at first. If the problem is sluggish performance, or squiffy video, or an application not launching, why would permissions have anything to do with it?

Well, OS X consists of thousands upon thousands of files, some of which are owned by the user and some of which are owned by the system itself, and each of them is set to be read or written or both by their owners or guests. And if any of those permissions on any of those files are not what they are supposed to be, things can get weird.

Open up Disk Utility in 'Applications > Utilities', then click on your startup volume in the left-hand column. Click the First Aid tab and then click on 'Repair Permissions' (there's a 'Verify Permissions' button too, but this is just for people who like to be told they have a problem without actually solving it – that's not us, is it?)

When you've finished, restart your Mac. With any luck, the annoying behaviour will have been fixed. Why? Who knows – be happy it's working.



Repair Permissions only affects Apple software, so if a permission problem has developed with a third-party application this won't help. It's also worth doing a Repair Permissions when you update OS X, just to make sure all is in order.

Next, zap the NVRAM. Back in the olden days (before OS X) a handy tool in every Mac troubleshooter's kit was "zapping the PRAM". This did not involve electrifying baby carriages, but rather meant resetting the Parameter RAM to factory settings.

Parameter RAM was a bit of memory in which various low-level settings were kept. Unlike the rest of the RAM it didn't erase when the Mac switched off, so whatever it contained stayed from one session to the next. Of course that also meant if anything went wrong with it, things would get weird and stay weird.

Nowadays there is still a bit of RAM that serves a similar purpose, but it's called Non-Volatile RAM, or NVRAM. If a permission repair hasn't fixed your Mac's difficulties, zapping the NVRAM might.

To do it, simply restart your Mac and hold down 'Command-Option-P-R' (the key combination hasn't changed from when it was PRAM). When you hear the startup chime twice, let go of the keys and the Mac will finish starting up. Note that you have to be using a USB keyboard for this – Bluetooth keyboards won't work.

Once you've started up, you'll want to open up System Preferences and check the Display, Startup Disk and Date & Time panes, all of whose settings will have been restored to factory defaults.

Like Repair Permissions, it's a blunt instrument. But if it fixes the problem, it's all good.

One of the things that's held in NVRAM is the log from the last time your computer crashed. When you zap the NVRAM that will be erased, so if you think you might want to show the log to a technician or someone at the Genius Bar, don't zap it.

FINALLY THE SYSTEM MANAGEMENT CONTROLLER (SMC)

This one's kind of a last resort, mainly because it's fiddly – especially for

kernel_task	1.12 GB	0 bytes	106	0	0	root
SophosWebIntelligence	828.5 MB	527.8 MB	4	4,061	280	root
iTunes	799.5 MB	0 bytes	46	3,157	62387	mjcp
Mail	702.9 MB	82.4 MB	20	2,994	16911	mjcp
com.apple.MediaLibrarySer...	644.0 MB	0 bytes	2	84	62389	mjcp
Folder Actions Dispatcher	476.7 MB	376.5 MB	3	137	450	mjcp
ITeleport Connect	248.4 MB	104.5 MB	9	196	476	mjcp
softwareupdated (Not Resp...	211.7 MB	44.7 MB	12	201	204	_softwareupda
loginwindow	184.8 MB	141.8 MB	2	526	75	mjcp
Dock	183.2 MB	93.2 MB	3	285	382	mjcp
mds_stores	179.8 MB	118.1 MB	2	64	221	root
InterCheck	165.8 MB	0 bytes	24	71	66215	root
SophosScanD	163.4 MB	0 bytes	11	70	66216	root
installD	149.7 MB	48.1 MB	2	79	879	root
SophosAntiVirus	144.7 MB	141.1 MB	6	67	241	root
Notification Center	137.1 MB	88.2 MB	3	197	442	mjcp
Unclutter	123.4 MB	29.5 MB	4	232	488	mjcp
storedownloadd	113.4 MB	18.2 MB	5	2,882	487	mjcp
Spotlight	113.4 MB	70.5 MB	8	266	392	mjcp
repair_packages	109.3 MB	0 bytes	2	30	66638	root
Mail Web Content	101.2 MB	15.6 MB	14	245	16920	mjcp
Mail Web Content	95.8 MB	17.3 MB	14	231	16918	mjcp

Sometimes applications or processes can crash and cause problems for the system, but they don't show up in the Force Quit menu. Here the System Update Assistant has crashed and is using RAM. You can kill such a trouble-maker using the Activity Monitor.

Physical Memory: 16.00 GB
Memory Used: 15.98 GB
Virtual Memory: 28.58 GB
Swap Used: 137.8 MB

MEMORY PRESSURE

App Memory: 6.76 GB
File Cache: 5.66 GB
Wired Memory: 1.73 GB
Compressed: 1.83 GB

laptop users. The SMC is a hardware component that manages stuff like the various blinky lights on your Mac, the temperature at which the cooling fans turn on, the brightness of the backlight and more. You can imagine the kind of things that can go wrong if the SMC does — though of course the complexity described above means that lots of problems that don't seem to be connected to the SMC actually are.

If you have a portable Mac with a removable battery, take the battery out and disconnect the power cord. Then press the power button for five seconds (it doesn't matter if you press it for too long). Then put the battery back, reconnect the power and switch on your Mac.

If you have a portable Mac with a non-removable battery, make sure the power cord is plugged in, then press 'Option-Control-left-hand Shift' on the keyboard as well as the power button. Release all four at once, then start up your Mac.

If you have a desktop Mac it's a simpler process. Just unplug the power cord, leave it for fifteen seconds, then plug it in and wait another five seconds. Then start up.

Hopefully, once you've gone through all of these steps, your Mac will be back to "just working" like it's supposed to. ■

Memory Clean by Fiplab can fix problems caused by fragmented RAM. It's updated for Yosemite and free in their App Store.

Memory Clean

14.01 MB
free memory available

Details

● App Memory	6.62 GB
● File Cache	5.79 GB
● Wired	1.73 GB
● Compressed	1.83 GB
● Used	15.98 GB
Total	16.00 GB

Clean Memory

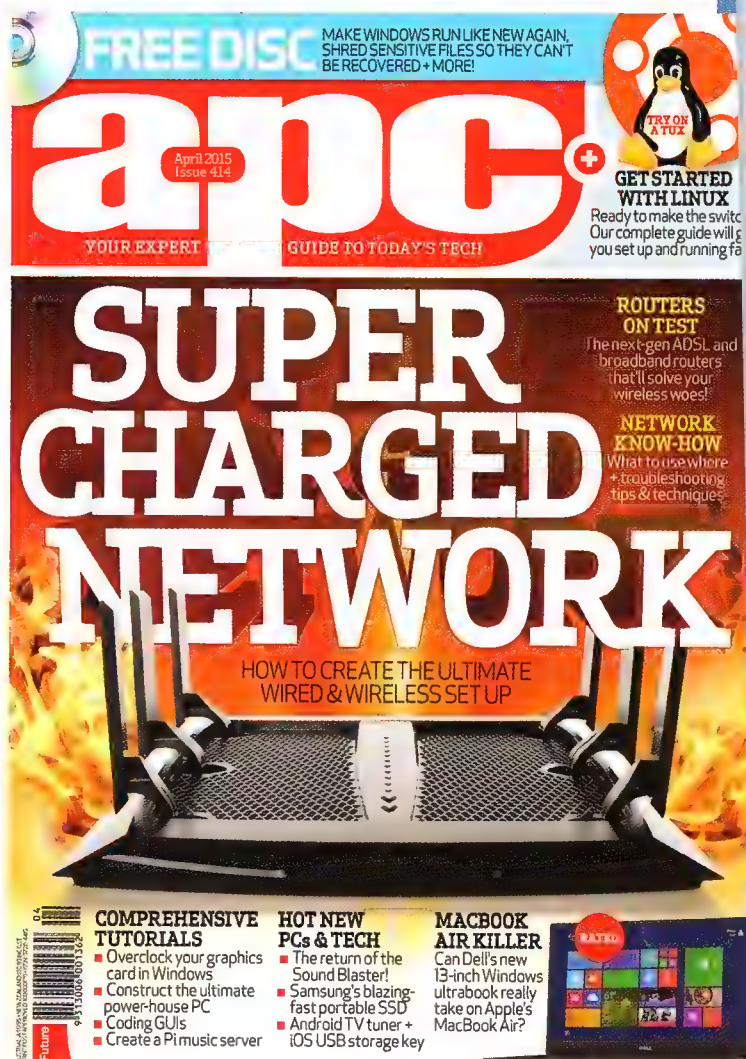
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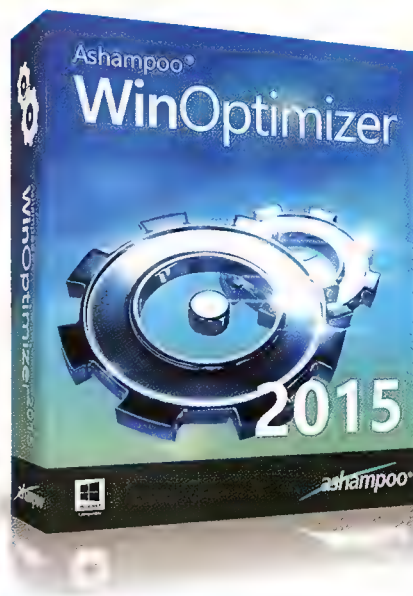
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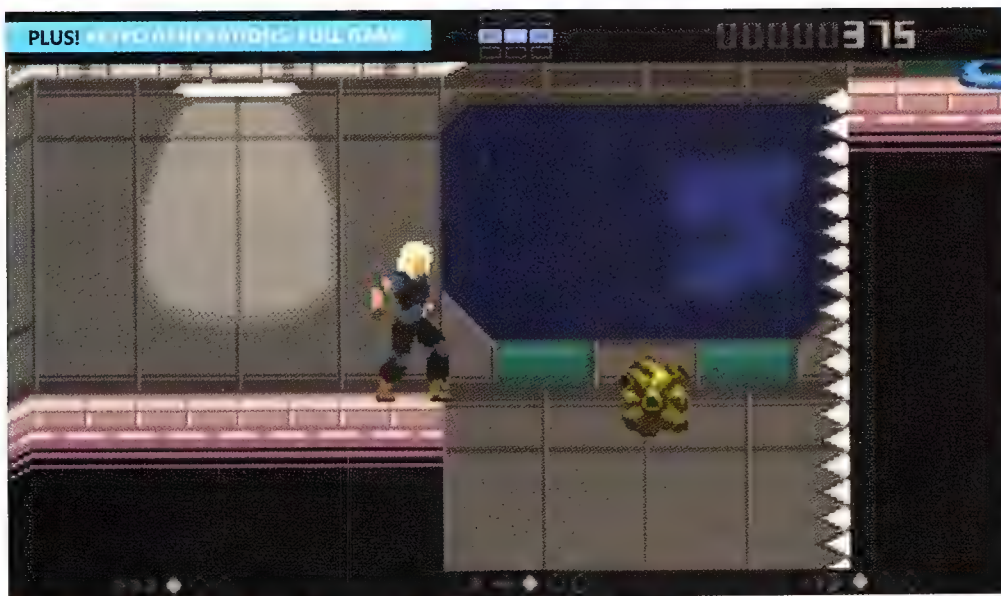


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- If you have any questions regarding the use of the APC disc, click the 'Help' button at the top of the screen.

USING THE DISC

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Power: states and governors

Jonni Bidwell dabbles with the many facades of managing power in Linux.

At one stage, power management on Linux was regarded as a bit of a joke. And we're not talking quirks with relatively advanced features such as hibernate and suspend — oh no, it used to be that a simple shutdown -h now could, rather than gracefully power off the system, send it into some nightmarish limbo state, whence one's only recourse was to hard reset the machine. Upon starting up the unfortunate machine, one might have to endure a lengthy fsck (we're talking back in the pre-journal days), which may unearth corrupted data. Worse still, hard drives could end up damaged following the whole ordeal. While these days are, for the most part behind us, many people still run into other difficulties with power management.

There are open standards which govern power management (also hardware discovery), namely the ACPI (Advanced Configuration and Power Interface) BIOS standard developed by Intel, Toshiba and Microsoft, and first released in 1996. ACPI replaced the old and no longer fit for purpose APM (advanced power management), which provided a rudimentary bridge between BIOS and the OS. An ACPI-aware OS is, among other things, able to react to button or lid events, triggering shutdown or standby states. Thus Windows 98, the first such OS, could do away with the 'It's now safe to turn off your computer' shutdown screen of its predecessor.

Unfortunately, motherboard manufacturers were not particularly adept at adhering to these standards, which was largely fine if people used the protocol-deviant Windows drivers provided with their motherboards, but it led to a world of pain for users of other OSs. Besides compliance issues, ACPI itself has come under fire, Linus in particular decried it as "a complete design disaster in every way" in 2003 (as is his way, he further advised any Intel employee having a hand in it to "shoot yourself now, before you reproduce"). His objections stemmed from, besides it being a generally

messy and overly complex system, the way that it requires AML bytecode to be run unchecked by the kernel. The ASL (ACPI Source Language) code which gives rise to this bytecode may not be available, which makes debugging a pain.

BUGGY BIOSes

The 2.6 series kernels heralded a new era of ACPI support, early (pre-2001), buggy implementations were blocked, and, in theory, a typical Linux PC circa 2004 could understand the six Power Sleep states S0-S5, Device states, Processor and Performance states. This was particularly helpful on laptops (which had recently become affordable and portable), whose users were able to at once conserve battery life and obviate lengthy boot times, courtesy of Suspend to RAM/Disk. New processors brought ACPI innovations into the server room too by throttling or powering down idle machines, temperatures and bills were lowered.

Unfortunately buggy BIOSes persist, particularly on machines older than five years, so if you do run into issues, it's worth checking if an updated BIOS is available from your motherboard manufacturer. If this doesn't solve your problem and you feel like an adventure, then read up on repairing



buggy DSDT tables. The Arch Linux wiki page is a good place to start wiki.archlinux.org/index.php/DSDT, but since the table needs to be embedded into your kernel image, you'll need to be au fait with kernel compilation. The kernel's documentation provides some good advice for debugging hibernate and suspend issues, too (see tinyurl.com/414debug).

All ACPI functionality used to be controlled by the acpid daemon, but much of it is now provided by either your desktop environment or Systemd. For the latter, you can specify what happens when you close your laptop's lid, push the power button etc, by editing the file /etc/systemd/logind.conf. The relevant options and actions are largely self-explanatory:

```
HandlePowerKey=poweroff
HandleSuspendKey=suspend
HandleHibernateKey=hibernate
HandleLidSwitch=suspend
```

```
Actions Edit View Help
0.1
.dsl 3355: CreateByteField (BUF6, \_SB.PCI0.VT86.ECP1.CRS.Y08_MIN, IOEL)
ing 3128: ResourceTag larger than Field ^ (Size mismatch)
tag: 16 bits, Field: 8 bits)
.dsl 3357: CreateByteField (BUF6, \_SB.PCI0.VT86.ECP1.CRS.Y08_MAX, IOML)
ing 3128: ResourceTag larger than Field ^ (Size mismatch)
tag: 16 bits, Field: 8 bits)
.dsl 3591: Method (CRS, 0, NotSerialized)
rk 2120: ^ Control Method should be made Serialized (due to creation of na
objects within)
.dsl 4033: Name (_HID, "NVRAIDBUS")
r 6033: ^ _HID string must be exactly 7 or 8 characters (NVRAIDBUS)
.dsl 4285: Method (RVLT, 1, NotSerialized)
ing 3115: ^ Not all control paths return a value (RVLT)
.dsl 4405: Method (RTMP, 1, NotSerialized)
ing 3115: ^ Not all control paths return a value (RTMP)
.dsl 4558: Store (GFSB (), Local0)
ing 3122: ^ Called method may not always return a value
.dsl 4584: Method (OCOP, 1, NotSerialized)
ing 3115: ^ Not all control paths return a value
.dsl 4600: Subtract (Local1, GFSB (), Local1)
ing 3122: Called method may not
.dsl 4876: Multiply (GFSB (), Local1, Local1)
```

This is what a broken DSDT looks like, the spec is rather fussy about the length of identifiers.

Ice ice, baby

Enhanced suspend and hibernate functionality is provided by the TuxOnIce kernel patchset. This allows, among other things, more control over the hibernate image: such as where it's stored, compression and the ability to encrypt it.

If you use the Ubuntu distribution then you can add the TuxOnIce PPA and install the kernel like this:

```
# sudo add-apt-repository ppa:tuxonice/ppa
# sudo apt-get update
# sudo apt-get install tuxonice-userui
linux-generic-tuxonice linux-headers-
generic-tuxonice
```

Arch Linux users can use the linux-ice package from the AUR, others will want to grab the patch from www.tuxonice.net and follow their distribution's instructions for compiling custom kernels. On non-Ubuntu systems, some additional

setup is required, and this is very much distro-dependent. This is mostly concerned with tweaks to the initramfs/initrd — the initial harness which Grub loads for the kernel. It needs to have resume support as well to load the lzo module so that decompression can happen.

TuxOnIce allows for nice progress bars to be displayed through the framebuffer layer during hibernate and resume. This is achieved through the fbsplash and tuxonice-uerui packages. It also allows you to interrupt the suspend/resume process or force a reboot. The TuxOnIce team also maintains hibernate-script a wrapper which provides easy access to both its own and uswsusp's hibernate back-ends. This means you can use the hybrid Suspend to Both state, which resumes quickly from RAM if the battery survived the break or slowly from disk otherwise.

```
HandleLidSwitchDocked=ignore
```

Of course, if you want to test things the grown-up way then you'll need some command-line fu. In particular, you can trigger power changes by writing directly to the `/sys/power/` state interface. For example, to enter the suspend (S3, STR) state, issue the following (as root):

```
# echo mem > /sys/power/state
```

Besides mem, you can also enter the slightly more power-hungry but faster-resuming freeze (S1) or standby (S2) states. Use disk to enter the hibernate (S4) state. For this to work you'll need to have a sufficiently large swap partition, since your RAM contents are going to get dumped here. They will be compressed, so even if your swap partition is smaller than your quantity of RAM it's still possible for this to work. The machine will shutdown (S5) once the hibernate image is written, so in order for it to resume we need to tell the kernel where this is located. This requires adding an option such as: `resume=/dev/sda2` as a kernel parameter, where sda2 is your swap partition. You can use the more robust (also more lengthy) UUID of said partition here, if you prefer. To effect the changes, as root add the desired option to GRUB_CMDLINE_LINUX in `/etc/default/grub` and then run `grub-update`.

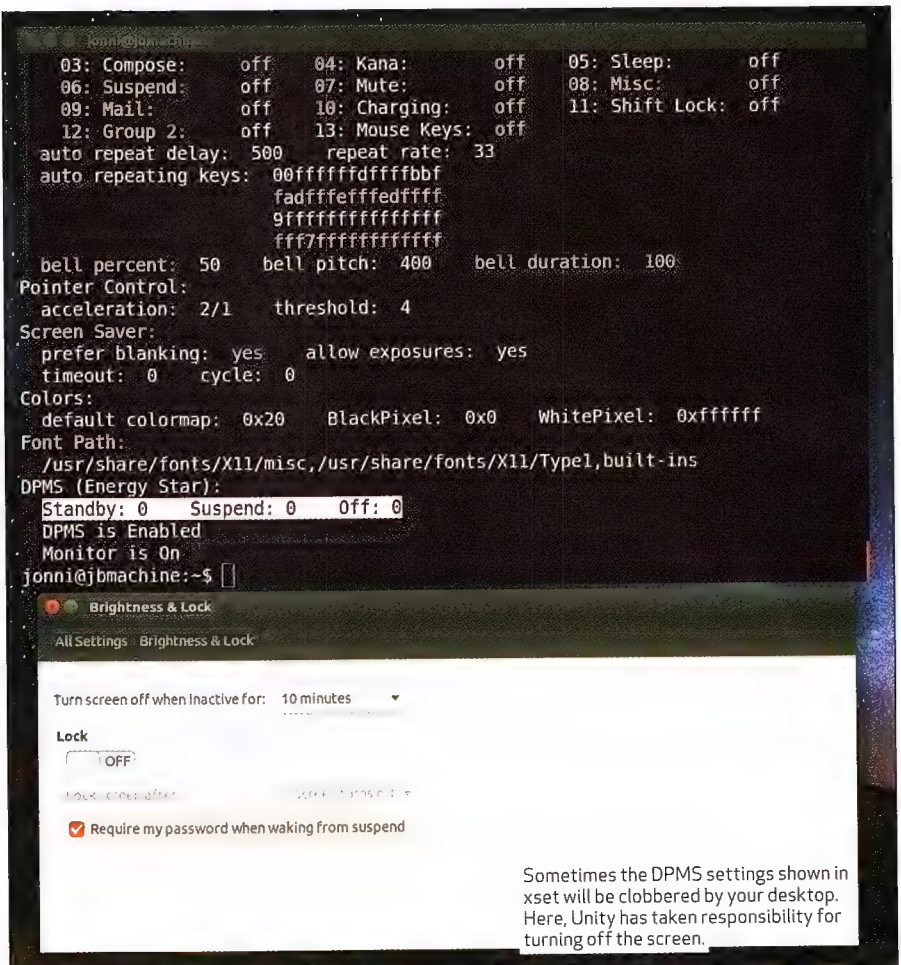
It is worth looking at pm-utils which is a collection of wrappers around the kernel's (or TuxOnIce's or uswsusp's) powerdown machinations. It provides workarounds for various motherboard quirks, as well as the ability to unload troublesome modules prior to suspending. A word of warning though: If a kernel update is applied, and then you hibernate your machine, and then resume it, then the new kernel will get very upset with the resume image.

So don't hibernate following kernel updates.

WHO'S THE GOVERNOR?

Modern processors (and even 12-year-old Athlon XPs if you have an nForce 2 motherboard and some time on your hands) all support some degree of frequency stepping. This is enabled (usually by default) in the BIOS. Intel's incarnation of this is dubbed Enhanced Speedstep and AMD's goes by Cool and

Quiet, or PowerNow. The idea is that, when feasible, the processor is slowed down and core voltages dropped (in some cases cores are powered off entirely). This means that system temperatures will drop, and, in turn, that fans can be slowed down and energy bills significantly reduced. Control of this mechanism is done through the kernel's CPUFreq subsystem, and is generally set up by default. Different profiles, which are



called governors, are available to suit various situations. You can check which one is active on your system with:

```
# cat /sys/devices/system/
cpu/cpu0/cpufreq/scaling_
governor
```

For a desktop system the default ondemand governor is generally the best choice – it will keep the frequency at its lowest until the CPU is stressed, then it will be raised as high as necessary, until the panic is over.

The governor is very responsive, capable of changing the frequency hundreds of times per second, so you won't notice any latency when more megahertz are required. However, you might notice some slowdown if you have a particularly variable workload, heavy compilation jobs for example, where the bottleneck oscillates chaotically between CPU and disk I/O operations. The other governors are: performance (keeps the CPU at its maximum frequency), conservative (switches frequency gradually, higher latency than ondemand), and powersave (lowest frequency). The latter might be something of a misnomer under heavy workloads though, since it would be more energy efficient to process these faster, rather than labour the CPU. The active governor can be changed by writing to

the /sys entry above as root, for instance:

```
# sudo -i
# echo performance > /sys/
devices/system/cpu/cpu0/
cpufreq/scaling_governor
```

Besides these, you can also set the scaling governor to userspace, which isn't really a governor in itself, but rather indicates that a userspace program will manipulate frequencies. Such a program is cpupower, which (replacing the deprecated cpufreqd) allows you to set custom minimum and maximum frequencies. In general, it's not necessary to install this, but you may want to do so nonetheless. For example, on old laptops it's common that too onerous a workload will cause overheating and the BIOS to lock the CPU into a cripplingly low-powered state. In this case it's convenient to preclude the CPU reaching its maximum frequency, which could be achieved with something like:

```
# cpupower frequency-set -u
1600MHz
```

You can examine the frequencies that are supported by your CPU with:

```
# cpupower -c 0 frequency-
info
```

where the -c option determines a particular CPU core. It's possible to set frequencies on a per-core basis too. In the event that this command returns unexpected results, eg that your CPU can only operate very much slower than its marketed frequency, then you'll probably want to investigate if a BIOS upgrade is available, particularly on older hardware. As mentioned earlier, manufacturers sometimes aren't very good at adhering to standards, which in this case results in the BIOS reporting inaccurate frequencies. If no update is available and you're happy to have your CPU running at full speed all the time, then you can always disable Speedstep et al in the BIOS.

If you install Intel's powertop program then you can see how much time has been spent in each frequency. Powertop also shows which programs are generating the most wake-ups, and can even tune various and diverse power-management settings through the /sys interface. Running

```
# powertop -html=powerreport.
html
```

will generate a report showing this information.

WAKE 'N BAKE

The system can be re-animated from the suspend or hibernate states by

PowerTOP report

file:///home/jonni/power/powerreport.html

POWER TOP

System Information

PowerTOP Version v2.7

Kernel Version

Linux version 3.18.6-1-ARCH

System Name

Gigabyte Technology Co., Ltd.GA-990FXA-UD5

CPU Information

8 AMD FX(tm)-8350 Eight-Core Processor

OS Information

Arch Linux

Summary CPU Idle CPU Frequency Software Info Device Info Tuning AHCI All

Target: 1 units/s

System: 301.5 wakeup/s

CPU: 3.9% usage

GPU: 0 ops/s

GFX: 38.3 wakeups/s

VFS: 0 ops/s

Top 10 Power Consumers

Usage	Events/s	Category	Description
0.7%	174.9	Process	lxqt-powermanagement
0.0%	45.6	kWork	od_dbs_timer
0.0%	28.5	Process	[rcu_preempt]
0.1%	24.7	Process	/usr/bin/python2 -OO /opt/sabnzbd/SABnzbd.py -l0
1.9%	0.05	Process	/usr/lib/systemd/systemd-journald
0.0%	6.0	kWork	os_execute_work_item
0.1%	5.1	Process	/usr/bin/terminal -d
0.0%	4.7	Process	/usr/lib/firefox/firefox
0.4%	2.5	Process	/usr/lib/xorg-server/Xorg -auth /var/run/sddm/{ab0c8b26-bdaf-404f-a75a-587d3ea4692e} -nolisten t
0.0%	2.7	Interrupt	[3] net_rx(softirq)

The idlewatcher component of LXQt's power management seems to be something of an attention seeker. Oh, the irony.

86 www.apcmag.com

keyboard or mouse activity. With well-behaved hardware though, one can also wake a remote machine by sending a so-called magic packet via the LAN. Note: this can work with specific wireless adaptors, but it's a hit and miss affair, so we're concentrating only on wired WoL here. The first thing to check is that WoL is enabled in the power settings of your BIOS. Then install ethtool and check that your adaptor (call it eth0) supports WoL:

```
# ethtool eth0 | grep Wake
Supports Wake-on: pumbg
Wake-on: b
```

The first line shows the type of packets which the adaptor can respond, in this case: PHY, Unicast, Multicast, Broadcast and magic packet activity. For WoL to work, we need this to be set to the latter. If this is not the case, make it so with: `# ethtool -s eth0 wol g`

This setting won't survive a reboot, so if you needed it permanently you'll want to add this command to your startup somewhere, either as a post-up networking script or through a udev rule. For the udev route, create a file `/etc/udev/rules.d/50-wol.rules` with the contents:

```
ACTION=="add",
SUBSYSTEM=="net",
KERNEL=="eth*", RUN+="/usr/
bin/ethtool -s %k wol g"
```

You'll need the MAC address of the target machine, since magic packets operate below the IP layer. This is a 12 hexdigit identifier which you can easily find out from: `# ip link`

Waking up the target machine will require a WoL application to be installed on the host machine. One such tool is provided by the wol package and you can also find tools for

Android and various other operating systems.

Having installed wol and got everything set up then hopefully you may awaken a slumbering machine with `# wol aa:bb:cc:dd:ee:ff` substituting for your target machine's MAC address. It's good practice to specify the machine's hostname or IP address with the `-i` option.

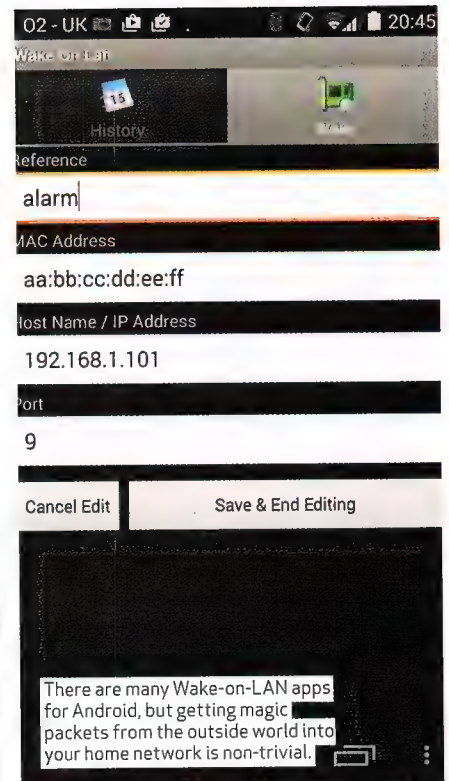
ARP MAGIC

Magic packets can, in theory, be sent across the internet too – they are usually sent as UDP datagrams to port 9, some routers, however, will have difficulty dealing with them. Forwarding traffic on UDP port 9 to the target machine's IP will not suffice, since our machine will not be stirred by these high-level noises. Instead, the router must be configured to forward this traffic to the broadcast address of the internal network (eg 192.168.1.255), and many devices don't permit this. It's possible to work around this if you have shell access to your router, for example if it's running DD-WRT or Tomato or something similar. The trick is to add an ARP entry with an unassigned IP address to the relevant interface, with the reserved broadcast MAC address FF:FF:FF:FF:FF:FF like this:

```
# arp -i br0 -s 192.168.1.254
FF:FF:FF:FF:FF:FF
```

and forward WoL traffic to this imaginary host.

If you are able to set this up, then the machine may be switched on remotely using the external IP or hostname assigned to your router (dynamic DNS services, such as duckdns.org are useful here) and the target machine's MAC address:



```
# wol -p 9 -i EXTERNAL_IP_
OR_HOSTNAME aa:bb:cc:dd:ee:ff
```

And that concludes our tour of power management. It was once a fragmented system, plagued by buggy hardware, and in many ways it still is. But it mostly works nowadays. Just not on Jonni's computer. ■

DPMS explained

All this fancy watt-saving is all well and good, but sometimes you need your machine, but not your monitor to stay on. The voodoo that controls the display's alertness is called DPMS (Display Power Management Signalling), the voodoo that makes the screen blank right before you want to use it, is one of life's great mysteries. In the majority of cases, some kind of screen blanking will work out of the box (even without an X server running), but it may not be just to your liking.

There are three gradations of sleep: Suspend, Standby, Off in order of decreasing power usage or increasing resume time. Some monitors don't recognise the difference between the first two.

If you're using a fully-featured desktop environment (or even a minimal one like the newly-released LXQt 0.9, then you'll be able to manipulate these settings graphically, but otherwise

you can change them by adding a file, say `/etc/X11/xorg.conf.d/12-dpms.conf` having the form:

```
Section "ServerLayout"
    Identifier "ServerLayout0"
    Option "StandbyTime" "45"
    Option "SuspendTime" "55"
    Option "OffTime" "60"
```

EndSection

Where the timeouts are specified in minutes. You can verify your settings by running `xset q`, if they're not what you expect then it's possible that a screensaver is overwriting your settings. The multi-talented `xset` can deal to that with a simple `xset s off`. You can also use it to experiment with the different sleep states, eg: `# xset dpms force standby`

iOS extensions in Safari

Alan Stonebridge shows you how to do more on your iPhone with extensions.

A long-standing complaint about iOS is the tight degree of control Apple exercises over what apps are able to do. Those restrictions have been relaxed in iOS 8 to allow apps to extend the system's capabilities in carefully defined ways. This means you aren't reliant on Apple adding support for a particular social network to be able to share something directly to it, and kludgy workarounds such as special bookmarklets that send a web page to an online service are no longer necessary.

Extensions enable photo-editing apps to make filters and tools available

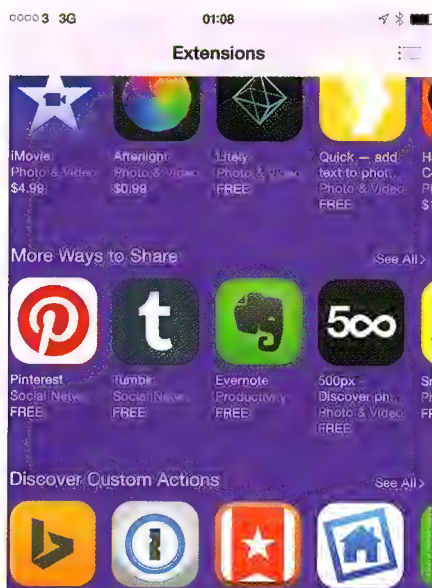
within the Camera and Photos apps. Information from apps can be displayed in widgets in Notification Center's Today panel, and acted upon from there. New keyboards enable entirely new input methods to be used, which can make life easier when typing into forms, for example. But it's the aforementioned ability to share a page to new places and perform new actions upon it, such as translating it between languages, that is particularly relevant in Safari.

We'll look at where to find apps that add extensions, plus how to activate and manage them.



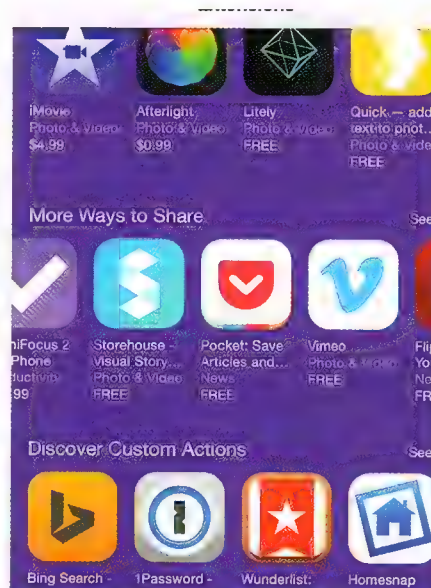
how-to

Find extensions.



1 FINDING EXTENSIONS

There's no Extensions category in the App Store because apps of all kinds include them. Apple showcases good examples at tinyurl.com/iosextensions. If you have a recent version of something there, you also have its extension, but you may not like an extension forcing its way onto the sheet that appears when you tap a Share button, so turning it on is left to you



2 EXTENSIONS FOR SHARING

Apple's curated selection is organised by the types of extension. Scroll each row horizontally to see highlights, and tap 'See All', towards the right of any row, for more. The bottom two groups contain Share and Action extensions, which is where you should look to add support for social networks and online services not accommodated by iOS itself.



Sign Up With Email

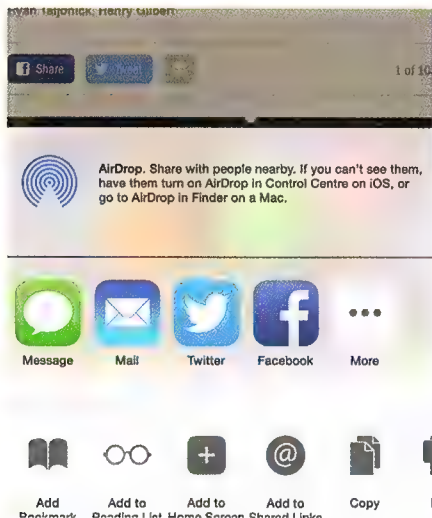
Log In

3 INSTALL AN EXTENSION

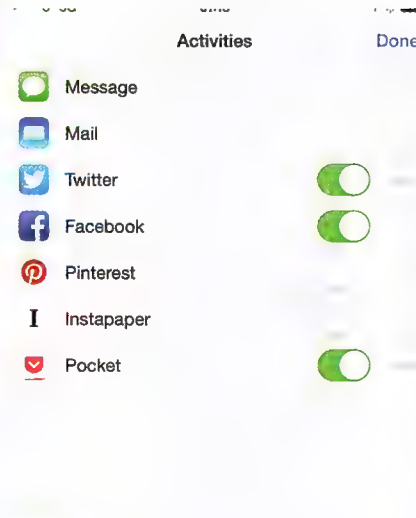
Pocket is a bookmarking service similar to Safari's built-in Reading List but with some organisational features that Apple's offering lacks. Download it now. That's all that's required to get an app's extension on your iPhone. Using this one requires an additional step, besides turning it on: open its app and follow the prompts to sign up for the free online service.

how-to

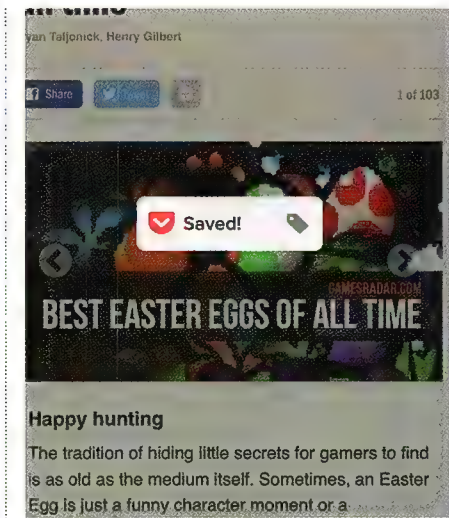
Manage and use extensions.



1 SEE WHAT'S AVAILABLE
After signing in through the Pocket app, visit a page in Safari and tap the Share button in the bottom toolbar. In the Action sheet, Share extensions appear in the middle row. They might send the page to an app or an online service, or post a link to it on a social network. Tap the More button at the far right of the row for a list of all available Share extensions on your phone.



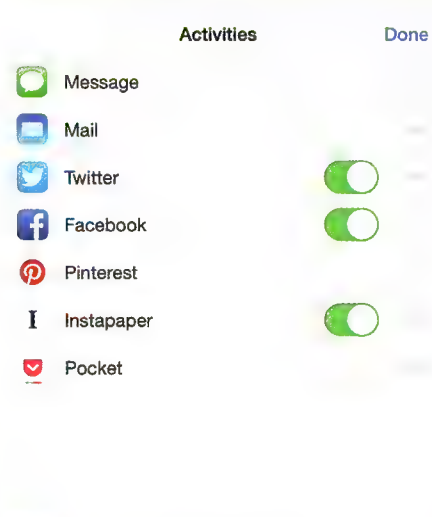
2 TURN ON AND REARRANGE
Switch Pocket on to make its extension appear in the Action sheet. Tap-and-hold on the rightmost icon in each line (the one with three lines), then drag up or down to change the order of enabled extensions in the Action sheet, saving you having to swipe to reach your favourites. (As of iOS 8.0.2, this setting seems to be forgotten when your device is restarted.) Tap Done.



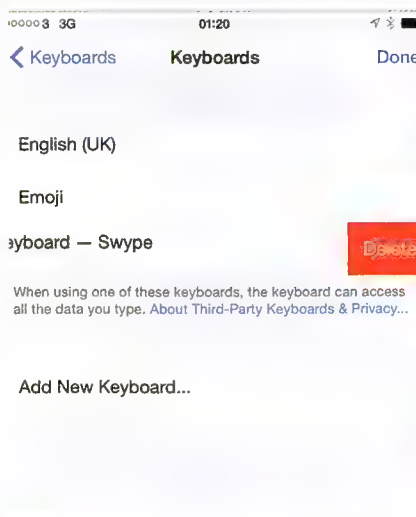
3 TRY IT OUT
Now tap Pocket's icon in the middle row of the Action sheet to save the current page to your account. On the right-hand side of the confirmation that appears in the middle of the screen, tap the tag to assign keywords – helpful if you save lots, and on different subjects. Open the Pocket app and it'll download the page you bookmarked so it can be viewed while offline.

how-to

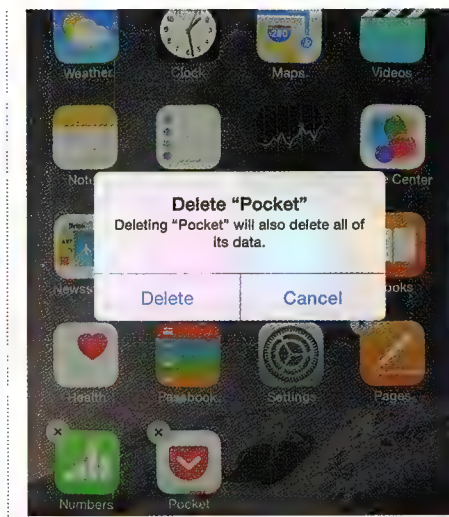
Disable and remove extensions.



1 DISABLE EXTENSIONS
If you decide to try out, say, a rival to an online service, because it promises additional features, you can temporarily disable the extension for your existing service without removing it altogether. With the alternative app installed, go back to the Action sheet and tap More. Switch off the old extension, and enable the alternative you want to evaluate.



2 DISABLE KEYBOARDS
Keyboards can be hidden from the list that appears when the smiley face/globe key is held down. Go to 'Settings > General > Keyboards', tap Keyboards at the top of that page, swipe right to left on the one to disable, then tap Delete. (Don't worry, this won't delete that keyboard from your iPhone.) Tap 'Add New Keyboard...' on the same page to re-enable it.



3 REMOVE EXTENSIONS
Extensions are properly removed from your iPhone only when you remove the app they came with. Tap-and-hold on the app's Home Screen icon, then tap the cross that appears at its top-left corner. If you later reinstall the app, iOS remembers whether its extensions — including keyboards — were turned on, but it may forget about your chosen order for them.



Build the ultimate powerhouse PC

"So an eight-core Intel CPU, three video cards, and a new Samsung SSD walk into a bar..." says Tom McNamara

Over the course of a year, hardware comes into the APC lair in trickles and deluges. We also end up stockpiling things we don't have an ideal use for. This month, a convergence of timing and opportunity leads us to this point: something kind of ridiculous, but also very good-looking and beefy. In other words, perfect APC material.

We try to do different kinds of systems for a variety of budgets, but sometimes it's just more entertaining to put dollar signs aside and assemble the craziest Voltron we have the parts for.

One piece of gear — the CPU cooler — is new enough to us that we haven't reviewed it before, while the Samsung 850 EVO SSD is fresh in the lab. In fact,

the drive was still under NDA (non-disclosure agreement) as we were putting this system together. That means we might have gotten in trouble if we'd even publicly confirmed its existence. Now we can pull back the curtains. Ta-da!

IF YOU BUILD IT, THEY WILL COME

We've been meaning to put the Corsair 760T full-tower case to use for some time. We've had it long enough that Corsair has produced the 780T as an evolution of it (we'll be getting our grubby hands on that one soon). This build will make ample use of a full-tower's dimensions, and the 760T has generous options for airflow. We've done two 980 video cards already, but not three. Powering them is a monster 1,600-watt EVGA power supply we've repurposed from the Labs Test Machine. It's a lot more juice than this system will ever need, even if we were to add a fourth GTX 980 and overclock everything to the hilt. But it seemed a shame for such fine equipment to go unused.

We've built for an eight-core Intel Haswell-E CPU before, but not actually used the full-blown eight-core job. We used 6TB hard drives in the Labs Test Machine, but not in a real-world build. And this is the first time we've used the Cooler Master Nepton 240M CPU cooler and the Samsung 850 EVO SSD together. We also have a motherboard from ASRock, which doesn't get a lot of representation at the premium tier. There's also 32GB of Corsair Dominator DDR4 RAM in the mix. But if this all sounds complicated, it's really more like LEGO parts than rocket science. The most time-consuming element is just giving the system a clean look after putting this much gear inside.

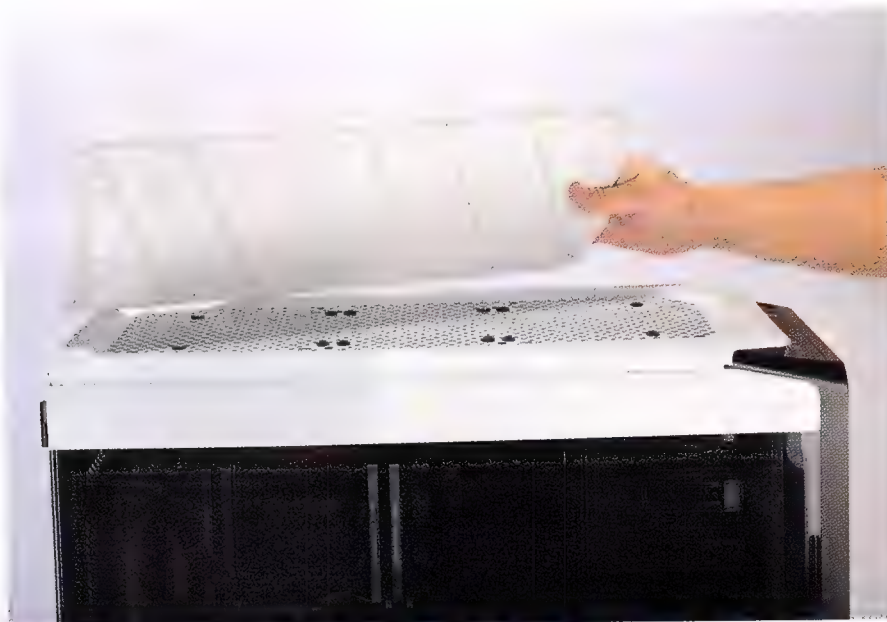
INGREDIENTS

PART		PRICE
CASE	CORSAIR GRAPHITE SERIES 760T	\$259
PSU	EVGA SUPERNOVA 1600 G2	\$439
MOBO	ASROCK X99X KILLER	\$440
CPU	INTEL CORE I7-5960X	\$1,439
GPU	3X NVIDIA GEFORCE GTX 980	\$2,475
SLI BRIDGE	EVGA PRO SLI BRIDGE (3-WAY/2-WAY)	\$39
RAM	4X 8GB CORSAIR DOMINATOR PLATINUM DDR4	\$1,045
HDD	6TB HGST ULTRASTAR HE6	\$745
SSD	250GB SAMSUNG 850 EVO	\$169
CABLE KIT	EVGA G2/P2 PSU CABLE SET	~\$25
OS	WINDOWS 8.1 64-BIT OEM	\$129
TOTAL		\$7,219

1 YOU CAN ONLY HOPE TO CONTAIN IT

Like the Corsair Obsidian 750D, the 760T has a magnetised cover on the top of the case. This time, it's hard plastic instead of a mesh. Since we're exhausting air and not pulling it in, the lower airflow isn't a big deal, and this style is a bit cooler-looking. The top of the 760T takes 280mm and 360mm radiators, as well. If you're into serious overclocking, then a CPU the size of the Core i7-5960X would benefit from larger rads.

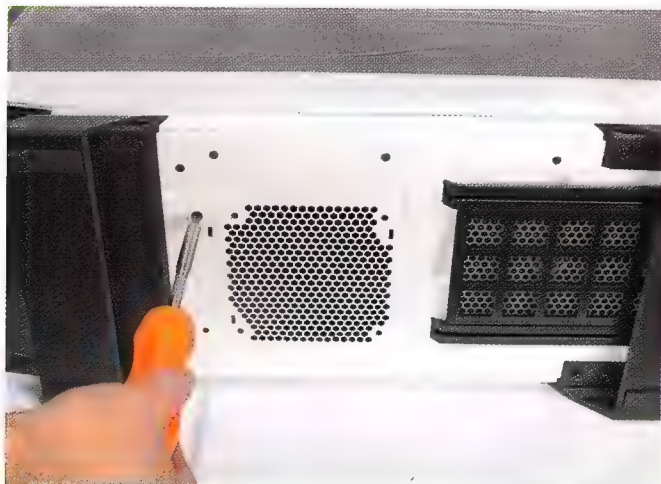
As its name implies, our Nepton 240M cooler uses a 240mm rad, which is fine for less ambitious octo-core overclocking. However, if you want to install your fans on the underside of the rad, the 760T uses rubber grommets for which the Nepton's mounting screws are too short. You can get a variety of machine screws at your local hardware store.



2 BECOMING UNHINGED

This next shot demonstrates a couple of interesting properties. The main one is the 760T's side panel. It's actually a swing-out door with a levered handle, like on the Thermaltake Level 10 GT. When it's rotated this far out, you can lift it off its hinge and set it aside. No screws to deal with. We've also removed one 3.5-inch drive cage and mounted the other one right below the 5.25 drive bay. We did that mostly just to see what it looks like, but also to help visualise the placement of custom water cooling gear like reservoirs and pumps. Our SSD is secretly mounted behind the drive cage, on the same plane as the motherboard.





3 DOWN UNDER

Looking at the underside of the case, we have a set of six screws holding down the two drive cages. Two screws hold down the cage that's closest to the front of the case. It feels secure despite being half as many as we'd like, and you don't need to remove the case's front foot to access the screws holding down the cage. Removing the four-screw cage reveals a 120mm fan mount. This is ideal for intake, but you'll have to keep an eye on dust or add your own filter. To the right of that is the intake for the power supply, which comes with a slide-out filter.



4 BUILDING BRIDGES

One of the fun things about building with Nvidia cards is their SLI bridges. This fancy job comes courtesy of EVGA, and its design matches that of our cards, which use the reference design of the base model. At \$40, the bridge is not cheap. But when this machine is powered on, the logo lights up green to match the lighting of the letters on the cards. The top section of the bridge is just barely short enough to wedge in underneath the case's pre-installed 140mm exhaust fan. It's one of the tightest clearances we've dealt with. You can flip it around and get a lot more space, but then the Nvidia logo is upside-down, which irks us. To get the GTX 980s installed this close together, by the way, you need to unscrew a raised plate near the cable connectors on the other end.

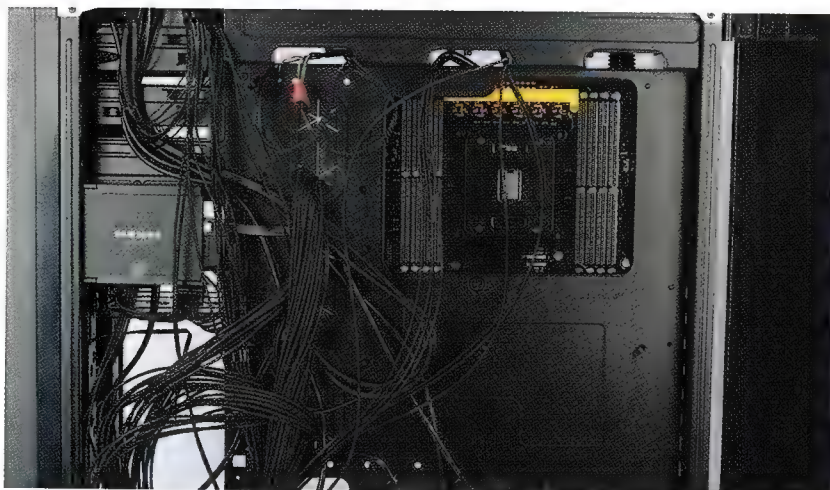
5 GETTING IN MY GRILL

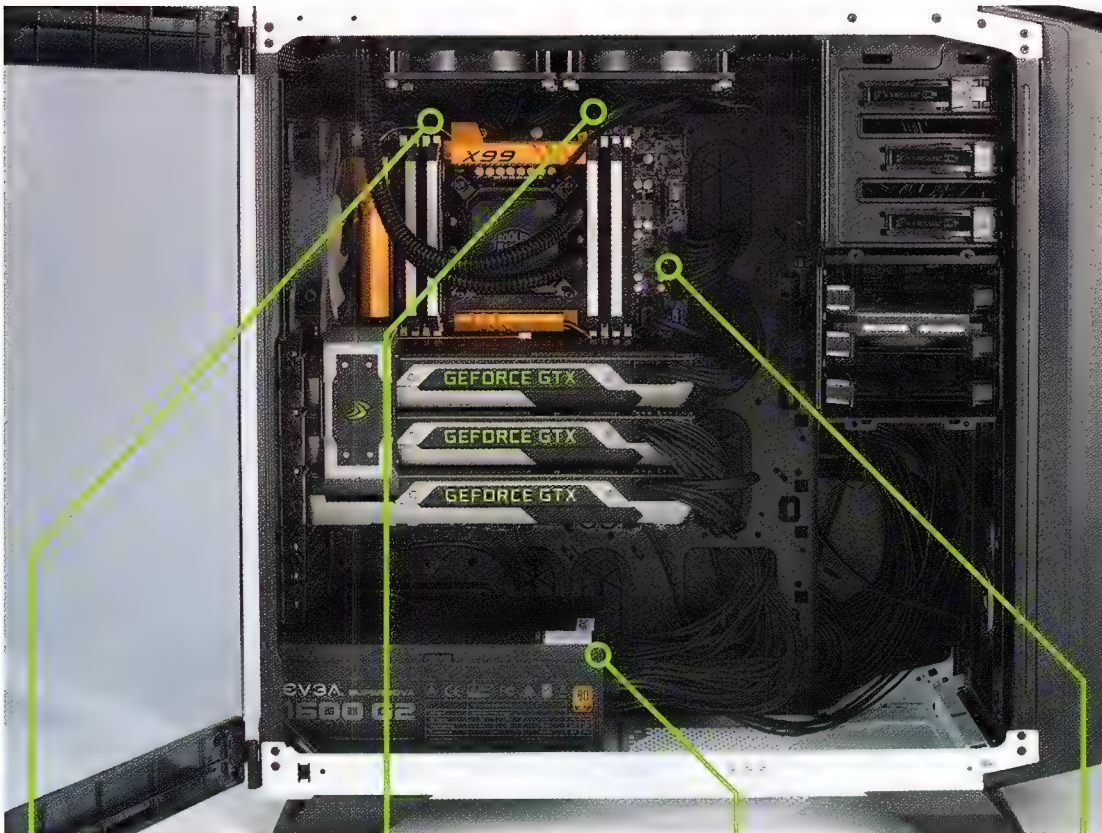
The front of the case has two 140mm fans pre-installed. The blades are made of clear plastic, presumably to let custom lighting shine through better. The case comes with a two-speed fan controller pre-installed, but we chose to skip it when wiring things up, in favour of testing the fan headers on the motherboard. We'd recommend a fan cable extension or two, because the cables on the front fans are not especially long. In contrast to the 750D, the fan grill on the 760T can be removed completely, making for easier access. In both cases, the grill snaps in and out easily. No screws or yanking required. If you remove the other 3.5 drive cage (or mount it over the 120mm fan on the bottom of the case) you could squeeze in a 240mm radiator, if you wanted. The 780T has even more room up front, enough to comfortably accommodate a 280mm radiator.



6 TANGLES AND DANGLES

With three video cards, five fans, and two storage devices, there's a lot of cabling. We switched to the kit of individually sleeved cables to lend some flexibility, but we'd have liked to have made more adjustments, if we'd had time. The case comes with four 2.5-inch trays, but we removed all but one to make room. Since we didn't wire up the fan controller, we fed its cables back, tucking them into the empty 5.25-inch drive bay. The 8-pin PCI Express cables have two of their six pins on a separate cable, so we snaked the spares up with the fan controller cables. (The reference GTX 980 needs only 6-pin cables.) The cable connecting the front USB 2.0 ports to the mobo was just long enough to reach. You can buy extension cables online.





- 1** The heatpipes on the mobo's heatsinks boost the heat the voltage regulators can handle, which helps with overlocks.
- 2** There's enough clearance above the motherboard to fit a 38mm radiator, rather than the standard 25mm kind.
- 3** This power supply has so many plugs to choose from that we can connect all of these while leaving enough space to install a fan below.
- 4** Like Intel's X79 motherboards, the X99 version has eight RAM slots and can take up to 128GB of DDR4 (but no DDR3).

The Three Musketeers

One of the advantages of working with an X79 or X99 system is its support of more than 16 PCIe lanes. The i7-5960X can wrangle a whopping 40 lanes, in fact. For a pair of high-end video cards, 16 lanes is enough, but just. With the rise of 4K, extra lanes are welcome. Even the best GPUs need to whip out the buddy system to handle a resolution that high.

With the GTX 980s, our gaming performance was 10–20% better than the system we assembled that had three GTX 780s and a hex-core i7-4960K. This month's system averaged 110fps in *Tomb Raider*, at 4K, with everything but antialiasing enabled, while the other system didn't hit 100. *Hitman: Absolution* also recognised all three cards, so we averaged about 100fps there.

The case's dimensions are also handy when wrangling this much hardware. Despite these cards being over 10-inches long, we didn't need to remove any drive cages to fit them in. And despite all that cabling, there's plenty of space behind the motherboard. Sometimes, after you're done hooking up, you need to basically squish the side panel down until you can secure it. Here, it was only a gentle push.

Now, the i7-5960X has a base clock of 3GHz, so we're never going to hit 5GHz like we did with X79. But because of Haswell's higher performance, plus the extra cores, multithreaded performance is hugely better. We got this rig up to 4GHz, very respectable for a 240mm closed-loop liquid cooler juggling up to 16 CPU threads. When those are all fully engaged, this chip will trounce 12-thread CPUs that reach 5GHz. For pure gaming, an i7-5960X is a poor choice, but highly threaded tasks like video encoding feast on power like this. Ultimately, we'd recommend a custom cooling loop to get the most out of eight cores. You'd probably want a roomier SSD, too. We used the 850 EVO because it's new and interesting. ■

APC Labs test machine: The machine compared here consists of a 3.2GHz Core i7-3930K and 16GB of Corsair DDR3/1600 on an ASUS Sabertooth X79 motherboard. It has a GeForce GTX 690, a Corsair Neutron GTX SSD, and 64-bit Windows 7 Professional.



Create a music server

Turn an old PC or a Raspberry Pi into a music-oozing jukebox.

Can you think of a more interesting use for an old unused computer than streaming music to your hi-fi speakers? With a little bit of geekery, you can cobble together a music streaming server that can play locally stored music as well as music from online streaming services such as Spotify. And you can control the contraption from another computer or even a smartphone connected to your local network.

At the heart of our setup is the Mopidy music server. Mopidy is capable of playing music from a variety of sources, so you can use it to stream music from online radio stations or services such as Spotify and SoundCloud just as easily as from the local hard disk.

Mopidy doesn't have a graphical frontend, and because we'll be controlling playback from a remote machine, you can simply install Mopidy on top of a bare bones Ubuntu Server installation to avoid putting any undue stress on the old machine.

INSTALL MOPIDY

Start by assigning a fixed IP address to the computer that will stream music. The most convenient way of doing this

is from your router's admin page.

For this tutorial, let's assume the server is 192.168.1.100. Log into the server and enter: `wget -q -O - http://apt.mopidy.com/mopidy.gpg | sudo apt-key add`

This fetches the authentication key for the repository. When you've downloaded the keys, you can add the Mopidy package repository with the command: `sudo wget -q -O /etc/apt/sources.list.d/mopidy.list http://apt.mopidy.com/mopidy.list`.

Once the repository has been added, you should refresh the package manager with `sudo apt-get update` before downloading the server with `sudo apt-get install mopidy`.

After the server is downloaded and installed, you can start it by simply entering `mopidy` on the command line. The music server creates a configuration file under your home directory: `~/.config/mopidy/mopidy.conf`.

You need to edit this configuration file to adapt Mopidy to your setup. Before you make any changes to the file, make sure the Mopidy server isn't running. You can stop the server by pressing the 'Ctrl-C' key combination in the terminal.

CONFIGURE THE SERVER

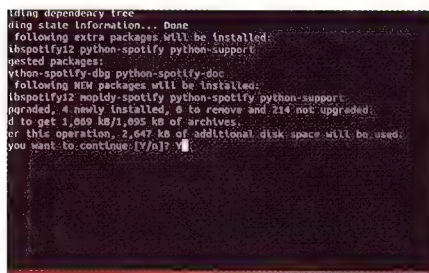
Mopidy has a lot of config values you can tweak, and the default configuration file lists some of the most useful ones. Mopidy exposes its functionality through a bunch of extensions. By default, the server ships with four core extensions that are enabled by default.

The 'Local' extension is used to play music from a locally connected drive. To point it to your drive, open the configuration file in a text editor and comment out the lines (by removing the # in front of them) under the [Local] section. Also remember to point the `media_dir` parameter to your music directory, such as `media_dir = /home/bodhi/Music`. Now save the file and ask Mopidy to scan all the tracks under the directory you've pointed to in the configuration file with the `mopidy local scan` command. Issue this command whenever you add new tracks to this directory, otherwise Mopidy can't play them.

You also need to enable some other extensions to be able to control your music server from remote computers and devices. Mopidy uses its own implementation of the popular MPD server. Thanks to this, you can control Mopidy with any MPD client.

Stream from Spotify

Hook up your media server with the music streaming service.



1 INSTALL

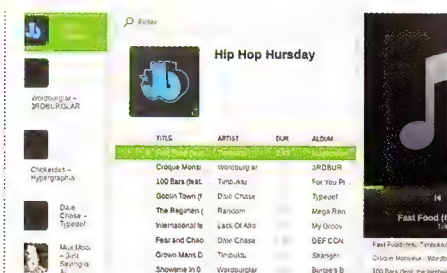
If you've followed the tutorial and have added the Mopidy repositories, you can install the Spotify extension with the `sudo apt-get install mopidy-spotify` command. But ensure you have a Premium account with Spotify — the extension doesn't work with free accounts.

2 CONFIGURE MOPIDY

If you have a Facebook Spotify account, get a device password from tinyurl.com/p8roavp. Stop the Mopidy server if it's running and open the Mopidy configuration in a text editor. Create a [spotify] section and enter your login.

3 STREAM!

Start the server. To stream music from the Spotify server, connect to your Mopidy server with a client such as the MPDroid Android app. To use a browser, install the Mopidy client (github.com/dirkgroenen/Mopify) following the walkthrough on page 97.

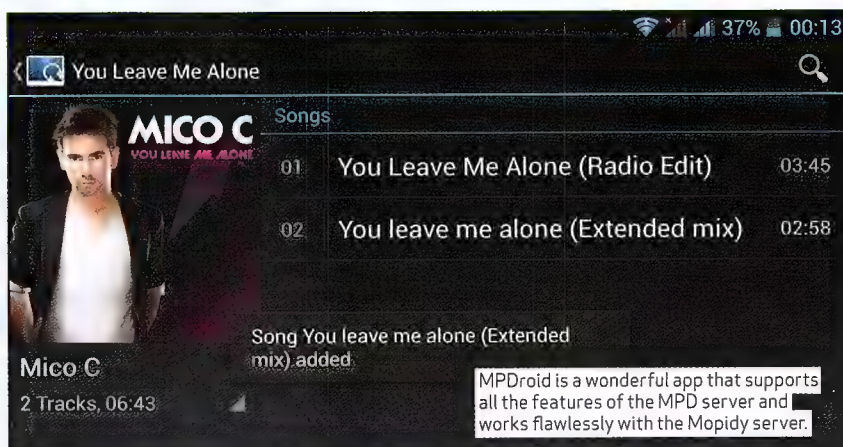


What is MPD?

The Mopidy music server implements its own version of the MPD server — however, the original MPD server can do a lot more than you can do with Mopidy.

MPD stands for the Music Player Daemon. It is a music player but, unlike typical desktop music players, MPD uses a client-server model. Separating the music player into two components has a couple of advantages. For instance, not only does it mean that MPD uses fewer system resources but it also introduces interesting possibilities, such as remote playback and control, and the ability to use different interfaces.

MPD can also handle audio files in a variety of formats, including Ogg Vorbis, Flac, MP3 and other formats supported by the FFmpeg library. It can also play Ogg and MP3 HTTP streams, can read and cache metadata, has native Zeroconf support, and a built-in HTTP streaming server. This is why MPD is ideal for running on low-powered headless servers, while the client can



run on any machine in the network. The Mopidy server's implementation of the MPD server inherits many of the features of the original MPD server. So, for example, you can control it remotely from any MPD client and search your music collection. However, there are several features that aren't available in Mopidy's MPD implementation. The biggest missing

feature is that Mopidy cannot stream music from the music server to the client. This means that you can only use the MPD clients to control the Mopidy server. Also, while Mopidy's MPD doesn't currently let you modify stored playlists, this feature will be available in a forthcoming version.

To enable the MPD clients to connect to Mopidy, uncomment the lines in the [mpd] section. The hostname variable should point to the IP address from which the server will accept connections. Because we want our music server to allow connections from any device that's on our local network, replace any address with a double colon, such as `hostname = ::`.

You should also enable the HTTP extension, which enables you to control Mopidy from any web browser. Again, uncomment any lines in the [http] section and make sure the hostname listens to all addresses from your local network. You can use the `static_dir` variable to point to the location of a web-based client, as explained in the walkthrough over the page.

"Can you think of a more interesting use for an old unused computer than streaming music to your hi-fi speakers?"

That's it. Now start the server with the `mopidy` command. When you enter the IP address of the server in a web browser on any computer on the network, you'll see the default web page of the Mopidy HTTP server.

The server is all set but you'll have to flesh it out by installing other components and extensions to control it remotely and be able to play music from online sources. You'll need to install a web client on the server before

you can access it from a remote machine. You'll also want to install a MPD client on a remote machine or on Android to control the music on the server.

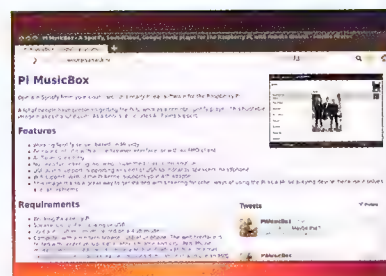
Once it's all set up, your music server will be all set to pump out music from the local disk or stream tracks from Spotify, and you'll be able to control it with your smartphone from anywhere in the house.

Mopidy on a Raspberry Pi

You can easily use a Raspberry Pi as your music server. Mopidy runs on both hard-float and soft-float ARM architectures, and can be installed from within the Raspbian distribution.

Before you can install Mopidy, you need to load the IPv6 module into the kernel with `sudo modprobe ipv6`, followed by `echo ipv6 | sudo tee -a /etc/modules` which makes sure the module is loaded on subsequent boots. Also, by default Mopidy outputs

audio from the HDMI port on the Pi. But if you've connected speakers to the AUX port, you must ask it to use the analog out with `sudo amixer cset numid=3 1`. Test the output with the command `aplay /usr/share/sounds/alsa/Front_Center.wav`. If you can hear sound from the speakers, add the `amixer cset numid=3 1` command to the `/etc/rc.local` file to make the change permanent. Your RPi is now set. Follow the tutorial to install and configure the Mopidy server.



If you don't want to manually set up Mopidy, you can get the Pi MusicBox distro for the Raspberry Pi.

Must-have Mopidy extensions

Make your music server do more!

```
bodhi@bodhi-Aspire-5738: ~/config/mopidy
.nfo
.png
.txt

[stream]
#enabled = true
#protocols =
# file
# http
# https
# mms
# rtmp
# rtmps
# rtsp

[gmusic]
username = geekybodhi
password = yetanotherplaintextpassword

[soundcloud]
enabled = true
auth_token = 1-35204-22335169-979f766d9d495d9
explore = electronic/Ambient, pop/New Wave, rock/Indie
(END)
```

```
bodhi@bodhi-Aspire-5738: ~/config/mopidy
.nfo
.png
.txt

[stream]
#enabled = true
#protocols =
# file
# http
# https
# mms
# rtmp
# rtmps
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username = geekybodhi
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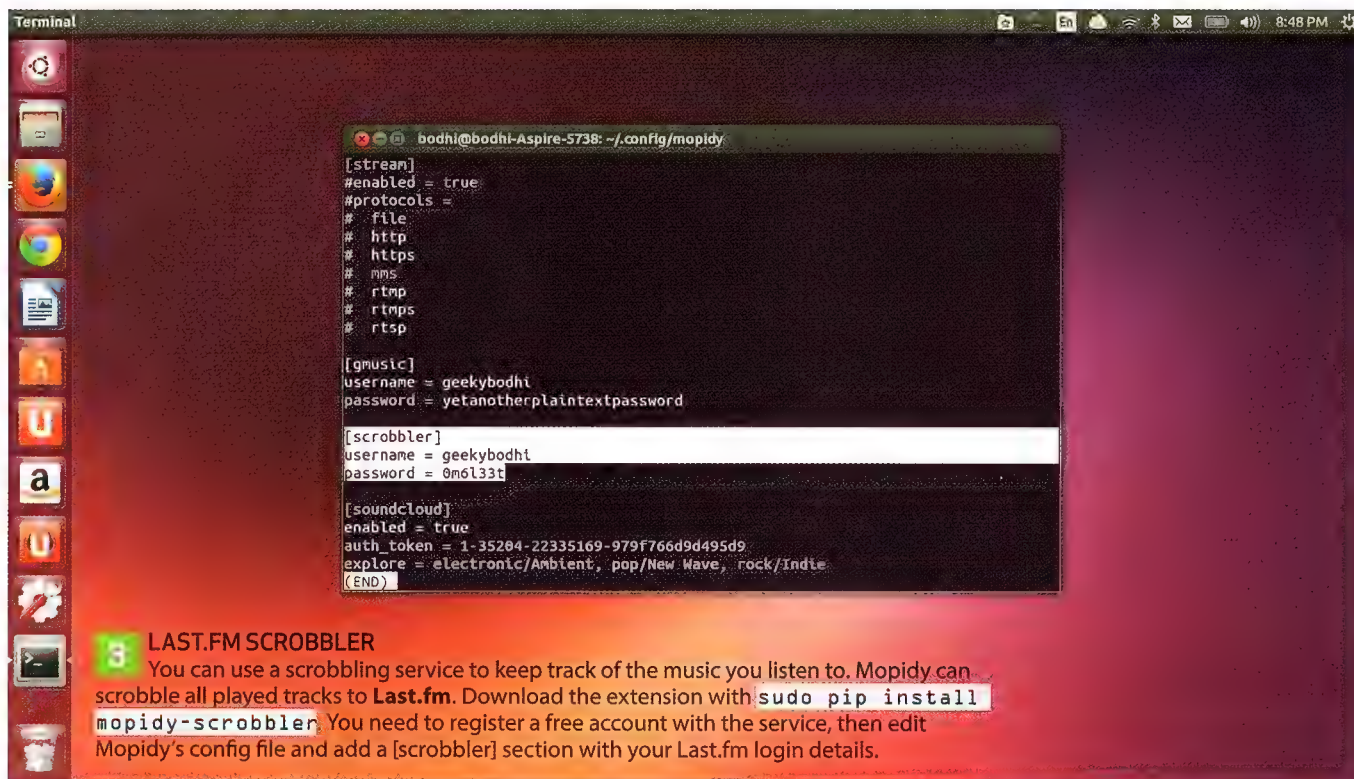
[soundcloud]
enabled = true
auth_token = 1-35204-22335169-979f766d9d495d9
explore = electronic/Ambient, pop/New Wave, rock/Indie
(END)
```

1 GOOGLE PLAY MUSIC

Mopidy can stream music from Google Play Music. First install the Pip Python package management system with `sudo apt-get install python-pip` then use it to install the extension with `sudo pip install mopidy-gmusic`. Stop the Mopidy server, and edit its configuration file by adding a [gmusic] section with your Google Play login.

2 SOUNDCLOUD

Mopidy can also fetch tracks from SoundCloud. Install the extension using the Pip package management system with `sudo pip install mopidy-soundcloud`. Then head to www.mopidy.com/authenticate and get a SoundCloud authentication token. Add it with the auth_token parameter to the [soundcloud] section in Mopidy's config file.



```
Terminal
bodhi@bodhi-Aspire-5738: ~/config/mopidy

[stream]
#enabled = true
#protocols =
# file
# http
# https
# mms
# rtmp
# rtmps
# rtsp

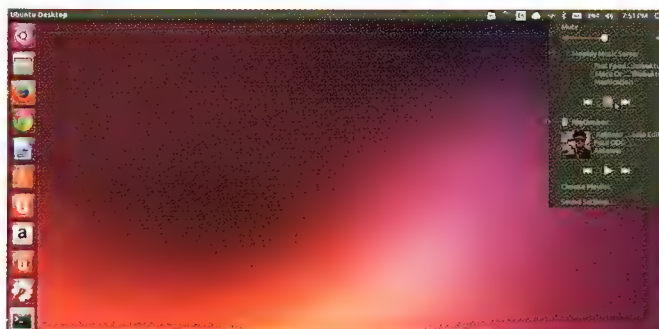
[gmusic]
username = geekybodhi
password = yetanotherplaintextpassword

[scrobbler]
username = geekybodhi
password = 0m6l33t

[soundcloud]
enabled = true
auth_token = 1-35204-22335169-979f766d9d495d9
explore = electronic/Ambient, pop/New Wave, rock/Indie
(END)
```

3 LAST.FM SCROBBLER

You can use a scrobbling service to keep track of the music you listen to. Mopidy can scrobble all played tracks to **Last.fm**. Download the extension with `sudo pip install mopidy-scrobber`. You need to register a free account with the service, then edit Mopidy's config file and add a [scrobber] section with your Last.fm login details.

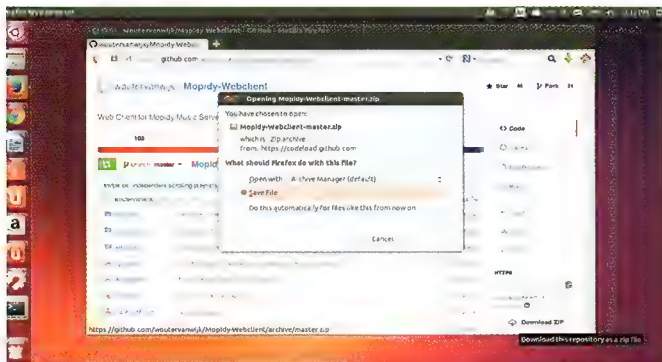


4 UBUNTU INTEGRATION

If you use Ubuntu, you can control the Mopidy server from Ubuntu's Sound menu. Just install the Mopidy extension for controlling the server through the MPRIS D-BUS interface with `sudo pip install mopidy-mpri`s. Unlike other extensions, this one doesn't require any configuration changes to Mopidy.

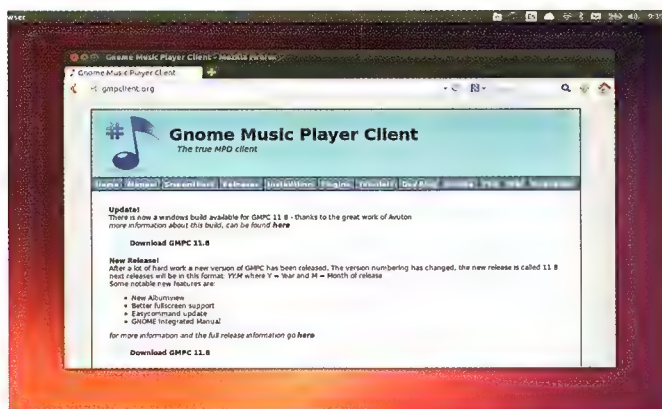
Add clients

Control your music server from the web, desktop and smartphone.



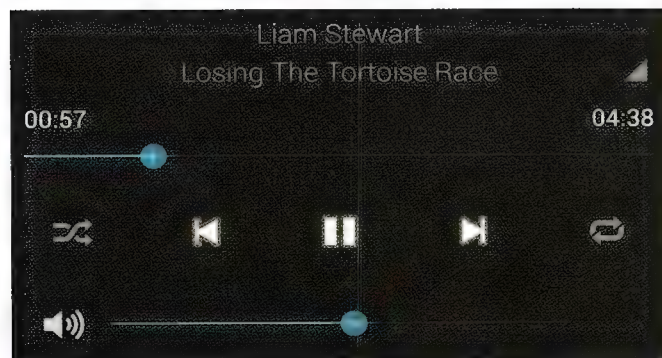
1 GET WEB CLIENT

With a Mopidy web client, you can control the server from any web browser on the network. There are several but we prefer the mopidy-webclient from github.com/woutervanwijk/mopidy-webclient. After downloading it, extract it and move the webclient/ directory from the extract contents to the /opt directory.



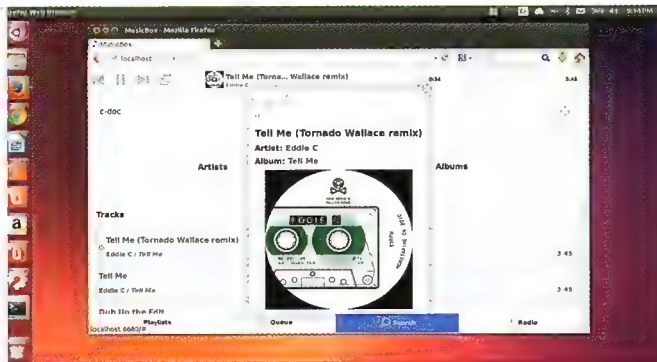
3 GET DESKTOP CLIENT

There are several desktop clients to control Mopidy from the desktop. We like the Gnome Music Player Client. Despite its name, it's available on Windows and Mac OS X, too. To install GMPC, install its repository with `sudo add-apt-repository ppa:gmpc-trunk/gmpc-stable` then refresh the package manager with `sudo apt-get update`.



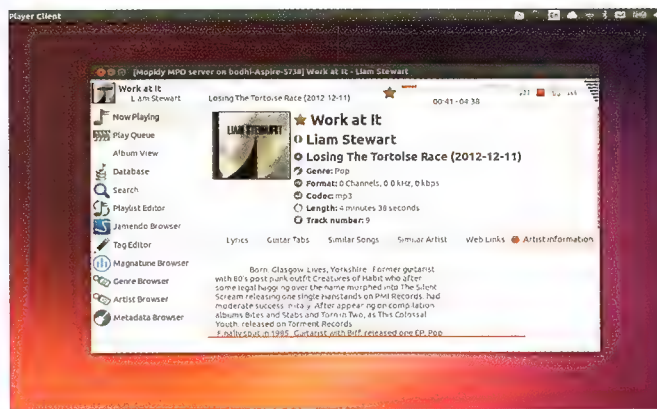
5 GET ANDROID CLIENT

To control the Mopidy server from an Android device, you need an MPD client. The Google Play Store lists a bunch of MPD clients, but we prefer MPDroid. The app is available for free and has user interfaces for phones and tablets. Using MPDroid, you can search your music collection and sort it by artist, album, genre and so on.



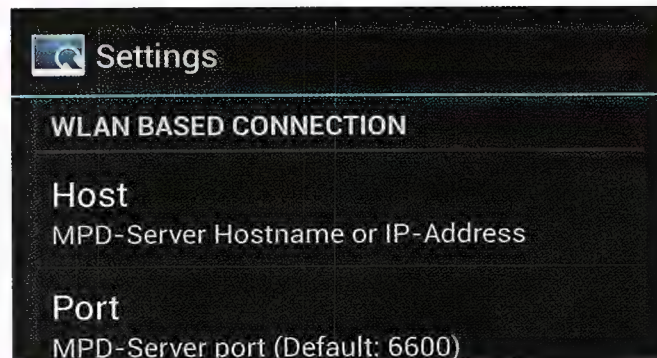
2 CONTROL FROM BROWSER

Open the Mopidy configuration file, scroll to the [http] section, and point the static_dir parameter to the webclient directory under /opt. Start the Mopidy server and enter its IP address on any web browser on your network. Instead of the default Mopidy web server page, you get the Mopidy web client interface to control playback.



4 CONTROL FROM DESKTOP

Install GMPC and its plug-ins with `sudo apt-get install gmpc gmpc-plugins`. When you launch the app for the first time, it starts a wizard to connect to Mopidy. Thanks to Zeroconf, your server is detected automatically (make sure it's running before launching GMPC), so all you need to do is select it from the 'Profile' list and click 'Connect'.



6 CONTROL FROM MOBILE

When you launch the app for the first time, you're asked to set it up. First select a preferred WLAN connection and your wireless network. Then tap on the 'Host' parameter and enter the IP address of the Mopidy server. Now head back to the main screen from where you can browse and control the music on your remote music server. ■

Is undervolting over-rated?

Everyone wants longer battery life, but how extreme are you willing to go to get it? Darren Yates looks into the dark art of mobile undervolting.



Can CPU undervolting give a Galaxy S3 'nearly two hours' more battery life?

When it comes to improving mobile battery life, we all know the drill. Minimise screen time and use of radio (3G/LTE, GPS) functions, avoid GPU-hungry apps. But if you're serious, there's an advanced hack popular in geek circles – undervolting your device's CPU cores.

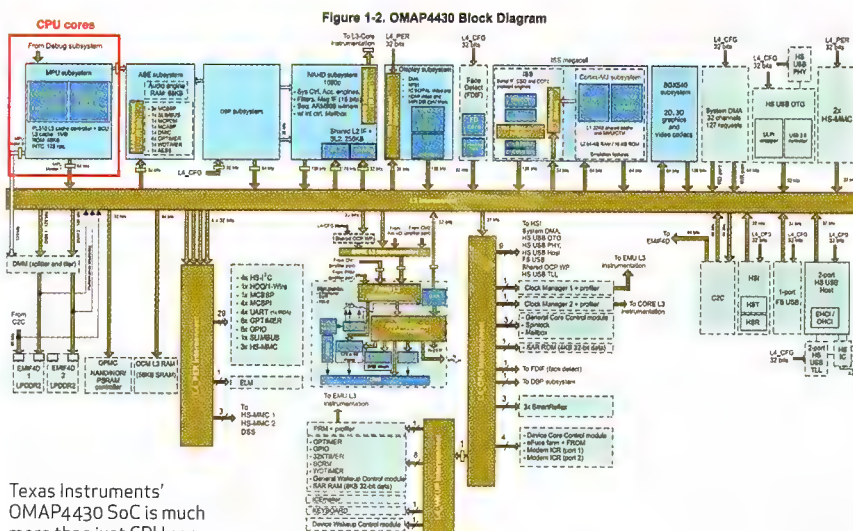
UNDER-WHAT?

CPUs consist of electronic switches called transistors. Without getting too techy, the speed at which these transistors switch on and off sets the CPU clock speed. And what affects a transistor's ability to switch at speed is the electrical voltage across it. In CPU-parlance, it's called the 'core voltage' or 'Vcore' for short. If you're familiar with PC CPU overclocking, you'll know raising the clock speed alone only gets you so far – you also need to increase the core voltage, which enables the transistors to run faster for greater gains. Of course, the downside of transistors running at higher voltages is greater power consumption and heat generation, which is why high-octane overclocking generally goes hand-in-hand with liquid-cooling.

But while you can overclock for greater performance, you can also undervolt CPU cores to reduce power consumption while maintaining original clock speeds.

HOW UNDERVOLTING WORKS

All modern CPUs have multiple clock speed steps that function like a gearbox to match the current software load (Intel called it 'SpeedStep' on its 1999-era Pentium III). When demand is low, the CPU throttles down to a lower clock rate and cranks back up as the load increases. CPU designers also discovered slower CPU cores could run on less voltage and continue operating normally, reducing power consumption. However, if the voltage was set too low at any one step, the CPU would freeze, requiring a hard-reset. So to maximise stability, CPU designers thoroughly test a CPU



design to find the lowest Vcore voltage at each clock step without crashing it (tinyurl.com/o9e2h3h). Those levels are then stored as a table in the chip with a safety margin added, ensuring overall stability.

Undervolting involves modifying those CPU clock-step voltage tables, reducing that stability margin and running the CPU cores at lower voltages to reduce power consumption.

The CPU process of automatically scaling the voltage and core clock speed is called 'Dynamic Voltage and Frequency Scaling' (DVFS, tinyurl.com/nf9lk3k).

WHAT YOU NEED:

Many Android devices potentially can be undervolted, but you need a few key ingredients:



- A device with root-access
- A kernel supporting CPU undervolting, your particular device and its Android OS
- An undervolting app (SetCPU, but there are others).

ROOT ACCESS

We've covered rooting your Android device previously, so we won't, here — particularly since there's no single root-access method that works for every device. If you don't have root-access yet, read my take at apcmag.com/how-to-hack-everything.htm.

NEW KERNEL

The most difficult ingredient to find will be the kernel — it's the engine of your Android OS. It'll be hard to find because not only is there a different kernel for every device, there's a different kernel for every Android OS release for every device. Add to that, you need a kernel supporting CPU voltage control. Be warned — you must get this right! Flash a kernel that's not designed for your device or its version of Android OS and you will brick the device.

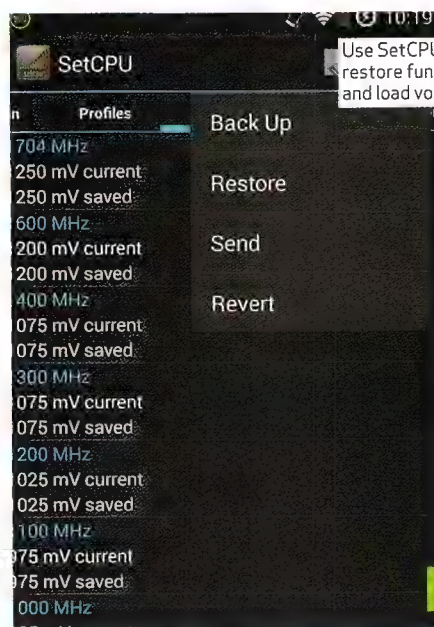
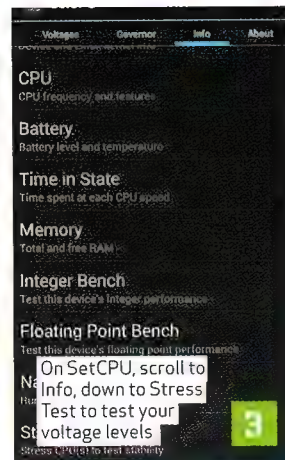
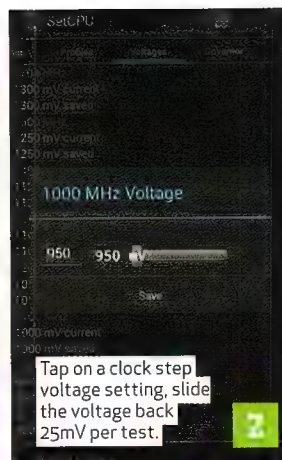
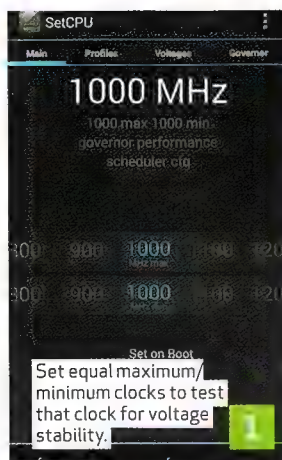
Even if your phone or tablet runs a custom ROM, that won't necessarily help. ROMs built on Google's AOSP (Android Open-Source Platform) with the stock kernel, including CyanogenMod, typically need a kernel replacement. For example, we tried a Samsung Galaxy S3 phone running CM11 (KitKat/4.4.4) and the stock kernel wouldn't have a bar of any voltage-setting apps. With so many devices, we can't provide kernel options for everything, but here are some popular alternatives:

- Google Nexus 4 – Matrx
- Google Nexus 5 – Franco, ElementalX
- HTC One M8 – Furnace
- LG G2 – Furnace
- Samsung Galaxy S3 – Boefla
- Samsung Galaxy S4 – Googy-Max3

Research your options first and again, make sure you get the right kernel for your device and Android OS version, otherwise your device is toast. Installing the kernel into an Android device is usually done via its custom recovery mode. We use CWMR (ClockworkMod Recovery) on the S3 — load the kernel zip file onto your device storage, boot into recovery mode, select 'load zip from storage', find the file and go.

SETTING THE CORE VOLTAGE

You set CPU core voltage levels with a kernel modifier like SetCPU (tinyurl.com/7fy33mn, \$2 on Google Play). Read this through before attempting it, but here's what we did:



1 Launch SetCPU, note the current CPU governor, the minimum and maximum clock speeds. Change the governor to 'performance', set both the maximum and minimum CPU core frequencies to the maximum level. Whatever you do, do not tick any 'Set on Boot' checkboxes.

2 Scroll across to the Voltages tab, scroll down to the current clock entry and drop the voltage level by 50-millivolts (50mV). Tap the Save Changes icon, second from right, at the top (this save isn't permanent). This will sound weird, but on SetCPU's Main tab, wobble the min and max clock rates around your current clock level. If the device doesn't crash, tabulate the clock speed and voltage on a piece of paper.

3 Scroll across to Info and down to Stress Test. Stress the CPU at these settings for five minutes — if all remains well, note the core voltage level, drop it another 25mV and retest. Repeat until it crashes and that's your voltage end-stop. If your device locks up, hold the power button down until it powers off and reboots — this should

reset all voltages back to normal (alternatively, temporarily remove the battery). Launch SetCPU again, but set the clock voltage level to 50mV above the last working result and write it down (this keeps some margin for stability).

4 Go back to Step 1, decrement the min/max clock speeds in lock-step and repeat the process again, this time starting with the clock-step voltage set to the last level from Step 3. Repeat until you've covered all clock steps and revert the CPU governor, minimum and maximum clock rates to their original values.

5 Export the new voltage settings using SetCPU's Voltages menu (Voltages tab, menu icon, top-right) and tap Export. Whenever you boot your phone, launch SetCPU, go back to the Voltages menu, select Restore and choose the saved settings (file called 'volumes.setcpumv'). Tap the Save Changes icon (second from right at top) to activate the new voltages. Again, do not tick any 'Set on Boot' checkboxes as this may result in your phone locking into a boot loop.

THE 'DEEP SLEEP' TEST

Letting the device go into 'deep sleep' mode will also test voltage stability. If the device won't awake from sleep mode, hold the Power button down until it reboots. Add 25mV to your voltage level sets.

DOES IT WORK?

This is the controversial bit. Of the many web sites we've seen that talk of undervolting providing battery-life improvement, few offer documented evidence. For example, sites we've seen claiming 'nearly two hours' of extra life on a Samsung Galaxy S3 by undervolting alone use tests that aren't generally available and therefore can't be repeated, provide minimal detail on the testing methodology, or offer no testing at all. The reality is undervolting is not an exact science.

WHY IT'S NOT STRAIGHTFORWARD

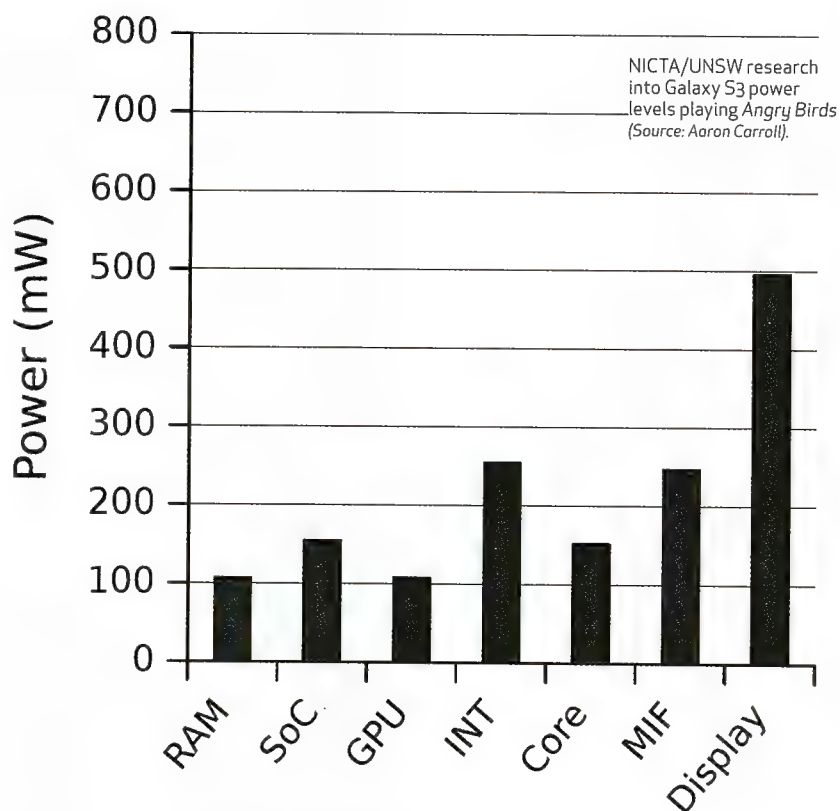
At this point, we need to look at some fundamentals. First, the key component drawing the lion's share of power in most non-gaming mobile applications is the display panel (and backlight mechanism if it's non-OLED). The CPU cores actually come in way down the list.

If we look at a little electronics theory for a sec, CPU core power consumption is proportional to the clock frequency multiplied by the square of the core voltage. So in theory, undervolting should have a reasonable effect on CPU core power. But to get the 25% effective improvement in overall battery life being claimed, the CPU cores would have to be consuming more than half the total power draw – and that only happens with software-decoded HD-video playback. Otherwise, as soon as you turn on the screen or start gaming, something else becomes the dominant load.

WHERE'S THE PROOF?

To prove my point, there's an excellent piece of research conducted by University of New South Wales Ph.D. student Aaron Carroll and Scientia Professor Gernot Heiser, in conjunction with NICTA, the Australian government's ICT research centre, into mobile device power measurements. Called 'The System Hacker's Guide to the Galaxy', it was published in 'Proceedings of the 4th Asia-Pacific Workshop on Systems' (APSys'13) and includes detailed analysis of the Samsung Galaxy S3 right down to sub-component level over a range of different applications (www.nicta.com.au/pub?doc=7044). Seriously, it's a must-read if you want to learn about mobile power consumption.

I've pulled out two key graphs – one showing idle power; the other, component power draw while playing



(a) *Angry Birds*

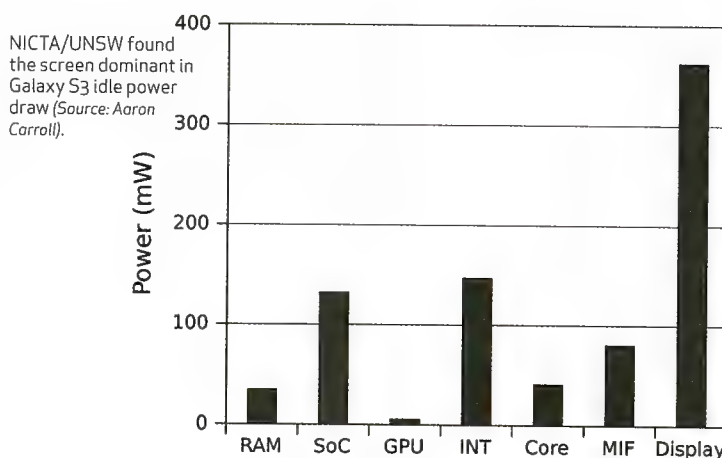


Figure 3: Idle power in airplane mode. $P_t = 805 \text{ mW}$.

Angry Birds. At idle, the total consumption was 805-milliwatts (805mW), with the display pulling around 360mW and the CPU cores (Core) barely making 50mW. Here, the CPU cores represent only 7% of total power consumption. Undervolting those cores alone won't get you two hours extra battery life.

It's a similar story with *Angry Birds* – here, the total power draw was 1516mW, with the screen the dominant component at roughly 500mW and CPU

cores managing around 150mW. Even if undervolting saved you half the CPU core power consumption – all but impossible, but let's say for argument's sake it did – you're only saving 75mW out of 1516mW, or 5%. There isn't two hours of extra battery life there, either.

To test this further, I ran GFXBench 3.0's built-in battery test on our Samsung Galaxy S3 running CM11 (KitKat/4.4) with the Boefla kernel. The test runs an OpenGL benchmark on the device 30 times, recording battery

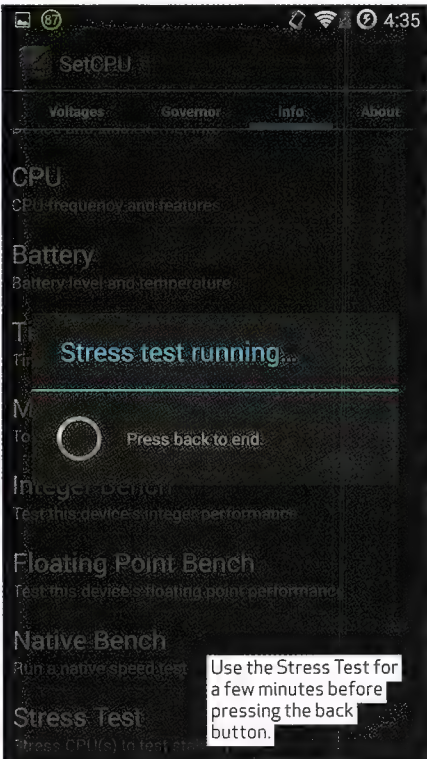
levels before giving an overall battery life estimate. With default settings, the estimate was 194.6 minutes. With undervolting and no other changes, it lifted to 206.8 minutes – a gain of 12 minutes or 6.2%.

THE INSIDE STORY OF SOCS

The ‘System on a Chip’ (SoC) units powering today’s mobile devices by definition contain far more than just CPU cores. For instance, note the block diagram of Texas Instruments’ OMAP4430 dual-core SoC that powers Google Glass. The actual CPU cores are the ‘MPU Subsystem’ block at the top-left corner, leaving a mountain of extras. The hardware-accelerated audio-video (IVAHD) engine, the GPU (PowerVR SGX540) and more are connected but separate processes in the SoC.

In short, you have to undervolt the whole SoC for more significant power reductions, not just the cores. SoCs do this to some extent – but to wildly varying degrees.

Android uses the Linux-based ‘CPUFreq’ framework to perform DVFS – when a new frequency is selected, CPUFreq looks up the corresponding voltage from the table and implements it. But as every SoC design is unique, they all perform DVFS differently. As the OMAP4430 shows, an SoC is divided into function sections. Each is powered by separate voltage sources called ‘voltage domains’, but not all domains support DVFS or support it to the same degree. For example, a CPU core voltage domain may have 15 of these clock-voltage pairs or ‘operating



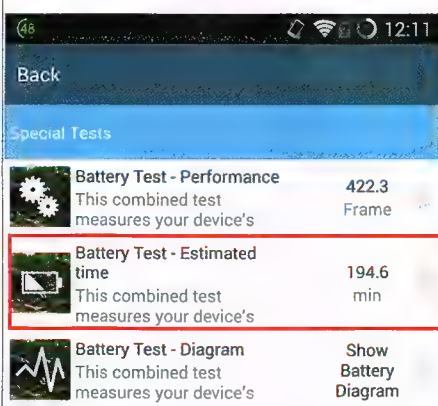
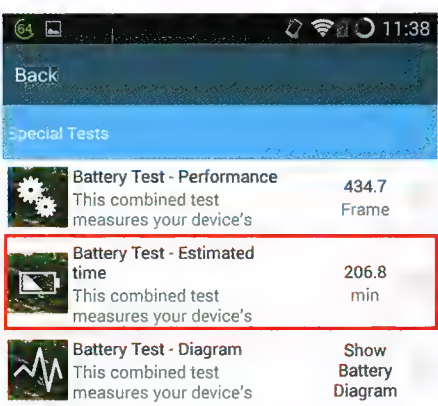
Original condition			With CPU core undervolting		
					
Undervolting gained 12 minutes or 6% extra battery life on GFXBench.					

Table 1. VDDARM, VDDSOC, and VDDPU Voltage Levels (for Reference Only)

VPU Frequency	ARM Frequency	LDO State	VDDARM_IN	VDDARM_CAP	VDDSOC_IN	VDDSOC_CAP/ VDDPU_CAP
0 to 352 MHz	996 MHz	Enabled	1.425 V	1.250 V	1.425 V	1.250 V
264->352 MHz	792 MHz	Enabled		1.150 V		1.250 V
0 to 264 MHz	396 MHz	Enabled		1.150 V		1.175 V
264->352 MHz		Enabled		0.950 V		1.250 V
Freescale's iMX6 uses different DVFS characteristics to the OMAP4430.		Enabled		0.950 V		1.175 V

performance points’ (OPPs), while other sections may have just three.

Freescale’s iMX6Quad SoC, for example, has one DVFS-capable voltage domain – VDDARM CAP for the ARM CPU cores. The VDDSOC CAP voltage domain doesn’t use DVFS and is separately controlled (Section 2.3 – cache.freescale.com/files/32bit/doc/app_note/AN4509.pdf).

By contrast, the OMAP4430 SoC has nine voltage domains, three of which support DVFS – VDD MPU L and VDD IVA L have five OPPs, VDD CORE L has only three (Section 3.8, OMAP4430 Data Manual – focus.ti.com/pdfs/wtbu/OMAP4430_ES2.0_Public_TRM_vJ.pdf). But added to that, OMAP SoCs also have a feature called ‘SmartReflex’ that monitors and sets the lowest voltages for parts of the SoC automatically. And we haven’t even begun talking about power management schemes or ‘governors’ or differences in kernels.

In short, battery life gains from SoC undervolting are a lottery. Not only is every SoC unique, natural variations in transistors further ensure you can’t even guarantee the same power reduction gains in samples of the same SoC.

IT'S YOUR CHOICE

We’re not saying ‘don’t undervolt’, but you should be clear about what you can reasonably expect to gain in terms of battery life improvements. Alone, undervolting can’t guarantee you two hours’ of extra battery life. Like most things in life, it’s not that simple. ■



SENSOR & MODULE

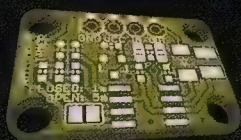
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A pair of infrared reflectance sensors mounted on one PCB, spaced just the right distance apart to build a line following robot. Symmetrical PCB with snapoff holes across the middle, so you can use it as a pair or cut/snap it in half to have two separate reflectance sensors.

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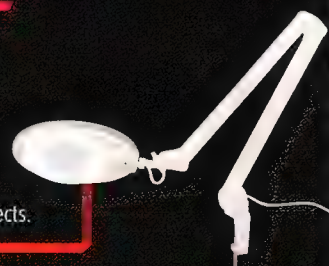
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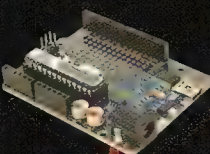
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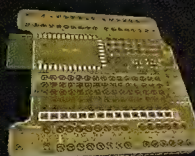
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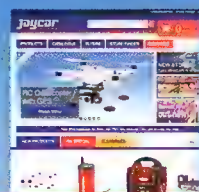
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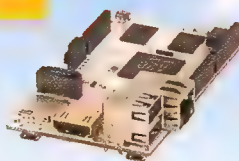
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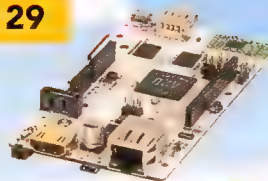
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XC-4352 PCDUINO NANO

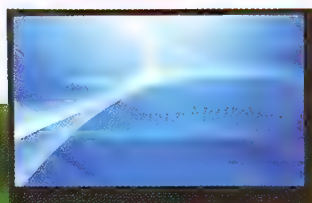
XC-4350 PCDUINO 3B

SoC	All Winner A20	All Winner A20
CPU	1GHz ARM Cortex A7 Dual Core	1GHz ARM Cortex A7 Dual Core
GPU	OpenGL ES2.0 OpenVG 1.1 Mali 400 core	OpenGL ES2.0 OpenVG 1.1 Mali 400 core
SDRAM	1GB	1GB
Flash Memory	4GB Flash	4GB Flash
Memory Expansion	microSD up to 32GB	microSD up to 32GB
Video Connection	HDMI 1.4	HDMI 1.4, LVDS
Audio Output	3.5mm Analogue	3.5mm Analogue I2S Stereo Digital
Onboard OS	Ubuntu 12.04	Ubuntu 12.04
Supported OS	Android 4.2 (ICS) / Linux 3.0	Android 4.2 (ICS) / Linux 3.0
Extension Interface	Arduino	Arduino
Network Interface	10M/100Mbps/1Gbps	10M/100Mbps/1Gbps Built-in Wi-Fi
USB Ports	2 x USB 2.0 & 1 x USB OTG	1 x USB 2.0 & 1 x USB OTG
SATA	SATA Host Socket	SATA Host Socket
Power	5V, 2000mA	5V, 2000mA
Size	96 x 60mm	121 x 65mm
RRP	\$89.95	\$129.00

XC-4356

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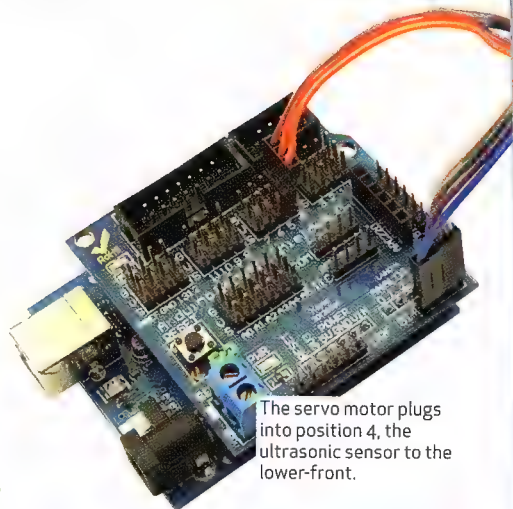


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Part #7 - Turning heads with Arduino

Learn how to use servo motors, as Darren Yates creates a rotating ultrasonic sonar using Arduino.



The servo motor plugs into position 4, the ultrasonic sensor to the lower-front.

Nothing says 'tech is alive' like movement and for movement, you need motors. There are many different types, but one of the most useful in hobby circles is the servo motor. It's not like an ordinary electric motor that spins as soon as you apply voltage to it. A servo motor like the one we'll use here is different – for a start, it has three connection points instead of two and the shaft doesn't (normally) make a full revolution when it spins. Instead, you program its position over a 180-degree arc.

A THOUSAND USES

Hobby-grade servo motors aren't perfectly precise in their programmed positioning, but they're pretty good. Weighing as little as a few grams, they're used in model aircraft to set ailerons (the hinged trailing part of a wing) and move a gazillion robots. Long-time APC readers will remember Stompy (tinyurl.com/oa7zzfs), my walking robot using nine of these little motors. The SG90 shown here uses plastic gears, so be gentle. Larger, more powerful servos with metal gears are available for more serious applications.

NEW SHIELD BOARD

The smart way to connect up servo motors to your Arduino is with a low-cost Arduino Sensor Shield v5.0 add-on board. You'll find these on eBay for under \$10, including shipping. It's designed to handle a wide range of sensors, but will happily control up to 20 servo motors (with a decent power supply) and even handle an HC-SR04 ultrasonic sensor, which is perfect for this month's project – a rotating ultrasonic sonar.

By mounting the ultrasonic sensor to an attachment arm that screws into the servo motor, we can rotate the sensor through 180-degrees in reasonably precise movements. If you remember our first project in our Arduino Basics series, we created a simple ultrasonic rangefinder (apcmag.com/arduino-basics-1-using-an-ultrasonic-sensor.htm). Now with the added servo motor, we can 'see' the landscape for barriers

over a 180-degree arc, a bit like a crude LiDAR (tinyurl.com/125bqun).

PUTTING IT TOGETHER

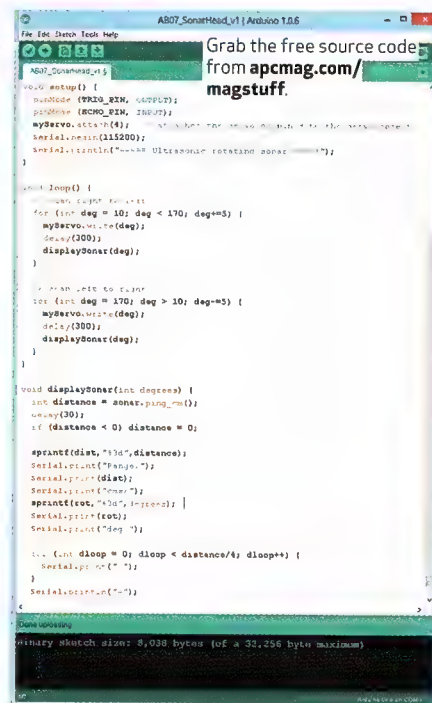
Plug the Shield into the Arduino Uno board and make sure the small jumper header is in position next to the reset button. The hobby servo motor should come with a small bag of arm attachments – find the one that's equal-length both sides and line it up under the ultrasonic sensors. As you can see from the photo, we used a couple of cable-ties to pull the board to the arm so that it's wedged just in front of the small crystal (the silver blob on the ultrasonic sensor board).

Plug in the servo motor cable header to position '4' on the shield – the pins are labelled 'G' (ground), 'V' (volts) and 'S' (signal). The brown wire connects to the 'G' pin.

For the ultrasonic sensor, you'll need four female-to-female Dupont/header wires or jumper leads – get them from eBay or Jaycar Electronics. Here, the blue wire connects to the '+' pin on the shield, the other end to the 'Vcc' pin on the ultrasonic sensor. The wire colours don't really matter, just make sure you start with the '+' pin on the shield to the 'Vcc' pin on the sensor and have the other pins follow in order.

POWER

Motors do consume electricity, but thankfully, small hobby servo motors not so much, so you can power this

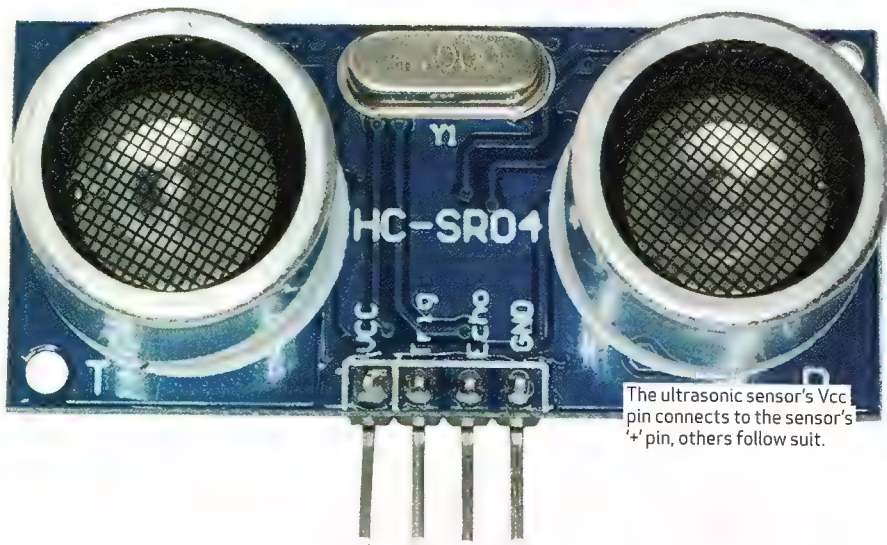


Grab the free source code from apcmag.com/magstuff.

project via the USB port of your PC. For future reference, any more than two small 'SG90'-grade servo motors in your project and you'll need to use external power (batteries make sense, but no more than 6-volts).

SOFTWARE

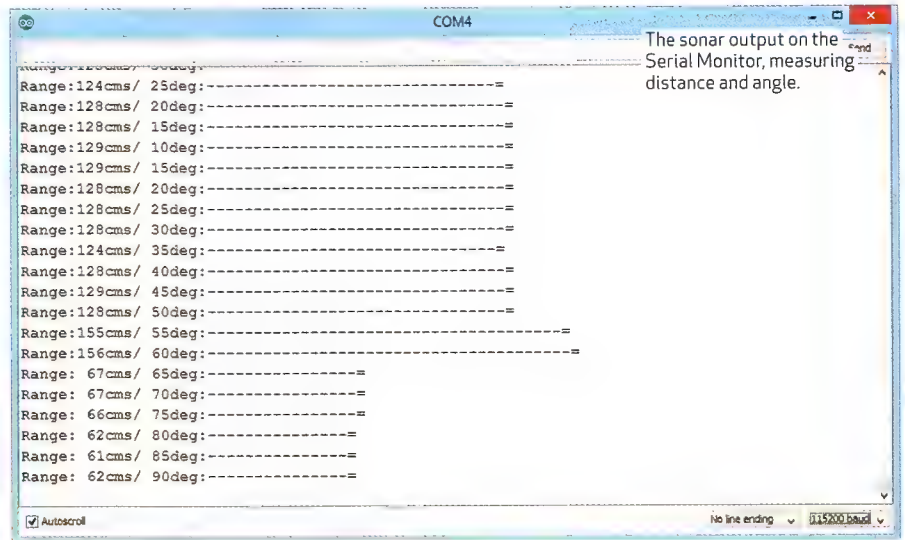
You'll find our source code for this month's project on our web site at apcmag.com/magstuff. Copy the



The ultrasonic sensor's Vcc pin connects to the sensor's '+' pin, others follow suit.



Use cable ties to anchor the ultrasonic sensor to the servo's arm attachment.



The sonar output on the Serial Monitor, measuring distance and angle.

contents of the zip file's /libraries folder to the /libraries subfolder in your Arduino IDE folder location. Load the sonarhead.ino source code into the Arduino integrated development environment or IDE (for now, we recommend the older v1.0.6 from arduino.cc/en/Main/OldSoftwareReleases).

HOW IT WORKS

Once you've programmed the source code into the Arduino, keep the USB cable in and tap the magnifying glass icon (top right) to launch the Serial Monitor. Ensure the Baud Rate is set to 115200 and you'll get a sonar-like display of what the ultrasonic sensor sees, listing the range (distance) and angle.

Arduino uses two main functions or methods – setup(), which runs once to initialise the various parts of your project code; and loop(), which cycles continuously until you remove the power or press the reset button.

In the setup() method, we initialise the pins for the ultrasonic sensor, A0 as the 'trig' (trigger) output and A1, the 'echo' return input. After that, we initialise the servo motor and attach the control signal to digital pin D4. Finally, we set up the serial monitor to 115200-baud and print our text header.

MOVING THE SERVO

To move the servo motor, you write the degree position you want as an integer to the servo object, here called 'myServo' with the codeline:

```
myServo.write(deg);
```

where 'deg' is an integer variable. Zero degrees faces compass-east and the servo shaft swings anti-clockwise 180-degrees to compass-west. We first create a for-loop to move from 10-degrees East to 170-degrees West in five-degree increments – at each point,

we wait 300-milliseconds and then find the range from the ultrasonic sensor. The reason for the 300ms delay is that the servo motor needs time to get into position before we start sending out ultrasonic pulses to measure. As soon as the measurement is completed, the for-loop kicks on, moves the servo another five degrees and repeats. Once it reaches 170-degrees, the next for-loop takes over and swings the motor back the other way with the same results.

To keep the loop() method tidy, we've broken out most of the commands into an extra method called displaySonar(int degree), which is called in each for-loop. We parse the current 'deg' value from the loop() method, which becomes the variable 'degree' inside the displaySonar() method.

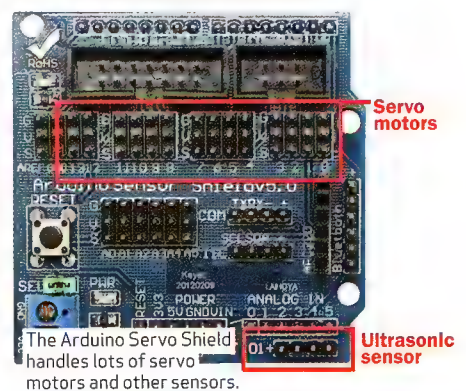
HAVE A GO

This is a simple and effective way of being able to 'see' what's not just in

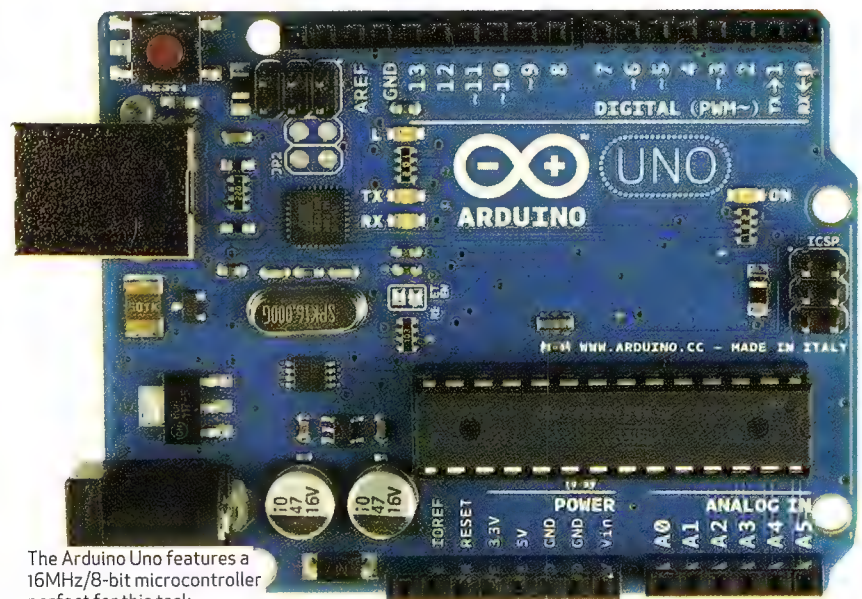
front of your robot, but what's off to the side, allowing you to compensate for any objects that might interfere. The ultrasonic sensor only has a range of about 2.5metres, but it's very low power, so won't drain your batteries as much as infrared alternatives.

Who knows – this could be the start of your own robot! ■

Arduino Sensor Shield v5.0



The Arduino Servo Shield handles lots of servo motors and other sensors.



The Arduino Uno features a 16MHz/8-bit microcontroller perfect for this task.

Part 7 - Coding GUI apps

You've got the basic tools, now it's time to build a bigger toolbox.
Darren Yates dives into coding apps with a graphical user interface.

So far in our Learn to Code series, all of the apps we've built have used keyboard-only input and displayed their wares via the system console (DOS prompt). The console is a great option for building simple apps, no question, and it's allowed us to get to know the coding basics quite quickly. But this month, we start playing with the grown-up toys and begin looking at how to build genuine graphical user interface or GUI-based apps.

GUI BASICS

Graphical user interfaces are the stuff all productivity apps are made from, and while good interface design is a science in itself (university subjects can cover this topic alone), the actual components are easy to learn. Every interface is made from a series of components, all of which are accessible to the Java programming language. In fact, Java actually has two component sets or 'frameworks'. It originally shipped with the Abstract Windows Toolkit (AWT), but later included the alternative called Swing Components. The difference is that while AWT essentially hooks into the operating system's application programming interface (API) to create some components, Swing draws its own, making it more independent of the OS and delivering a more consistent interface across the different platforms. However, Java still relies on both, using AWT for the basic stuff and Swing for the rest.

YOUR FIRST GUI APP

Just about any general-purpose programming language can create a GUI application and you can do a very basic app in Java with around half-a-dozen lines of code. Grab hold of our source code pack for this month's edition from our web site at apcmag.com/magstuff. Unzip it, unzip the FirstGuiApp file archive and load the FirstGuiApp.java source code into the NetBeans IDE. (Don't have NetBeans? Get it from netbeans.org/downloads, but make sure you install the latest Java Development Kit or JDK first.)

The very first thing you need to create a GUI app is what's called a JFrame, a window on which you'll draw everything else to do with your app. All of the code that matters for our app appears inside the 'main' method. The



first line creates the JFrame object imaginatively called 'frame' and gives it the title 'Hello World! - from APC Magazine'. Next up, we set the size of the JFrame using the 'setSize' method, giving the width and height of the frame in pixels. We've made ours 600 pixels wide by 400 high for no particular reason. The following line then tells Java how to set the location of the new frame - by setting the location relative to nothing (null), we're just saying 'create the frame and plonk it in the middle of the screen'. You don't have to tell Java where the centre of the screen is, either - it's clever enough to figure that out for itself.

The fourth line in the main method tells Java what to do with the app when we close the frame - that is, when you hit the top-right Windows close button. In this case, we're telling Java we want to close the app when the window closes (EXIT_ON_CLOSE). Without this line, closing the frame would keep the app alive but hidden - this can be useful depending on the context of your app, but for a simple app like this, closing the frame should also close the app. Responsible coding means you release system resource like memory when you're finished with them, so they're available for other apps.

And finally, the last line tells Java to make the frame visible, so it can be



seen on the screen. Putting this codeline last when creating your interface is a good habit to get into because it ensures the frame isn't shown until drawing of all components is completed. In extreme cases, make the frame visible first can reveal the other components being drawn one-by-one - it mostly happens in a flash, but it's just good coding etiquette to set up the frame first before you make it visible.

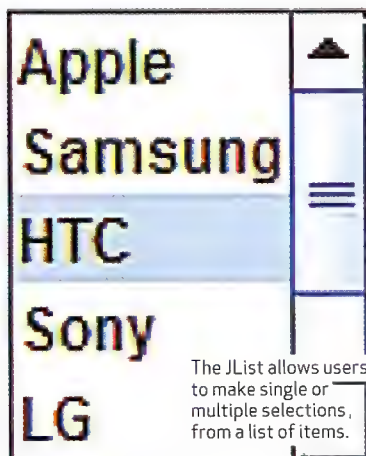
Run the app and you'll see it does nothing other than draw a frame with a title. Think of it as the blank canvas on which you'll build your app masterpieces!

ADDING GUI COMPONENTS

Now we get to the fun bit - adding components and building up the user interface. Rather than get too technical this month, we're just going to introduce a whole range of components into a second app you'll find in the zipped folder called 'GuiComponents' to show you how they're defined and called. These components aren't specifically coded to do anything in the app, but you'll find some (like the JTextArea) have plenty of built-in functionality ready to go.

JLabel text relative-placement

Use a JLabel to draw an image and you can set the location of any label text.



Here's just a few of what you'll find:

JBUTTON

This is the standard command button in Java and few apps will get by without at least one of these somewhere. JButtons can be operated by a mouse left-click or you can tap them if using a touch-screen device. You can add text to the button and even give it an icon if you wish. There's nothing you need to do to enable touch-screen operation – it all happens automatically, courtesy of the operating system.

JCHECKBOX

The JCheckBox allows you to add on-off style custom feature switching to your apps without the user having to dive into a menu (you'll probably see them in printer driver software, for example). Again, its left-click or tap operation and they're a toggle mechanism – click-on, click-off.

JTEXTFIELD & JPASSWORDFIELD

TextFields are a single-line text input component you implement to allow a user to type in their name or address or whatever. You can preload it with text and set the default visible length of the field. You can even set the font type, style and size.

JPasswordField, on the other hand, is the component you use when asking the user to enter a password and want to keep that text hidden. You can load

it up with default (hidden) text and again, set the default visible length.

JRADIOBUTTONS

JRadioButtons perform a similar function to JCheckBoxes but with one important addition – you can link multiple radiobuttons together and have them function in a mutually-exclusive fashion. In other words, you can choose any one but only one of the buttons at a time. This is optional and the way you do it is to add the JRadioButtons to a ButtonGroup, which we do with the codelines:

```
radiogroup.add(radio1);
radiogroup.add(radio2);
radiogroup.add(radio3);
```

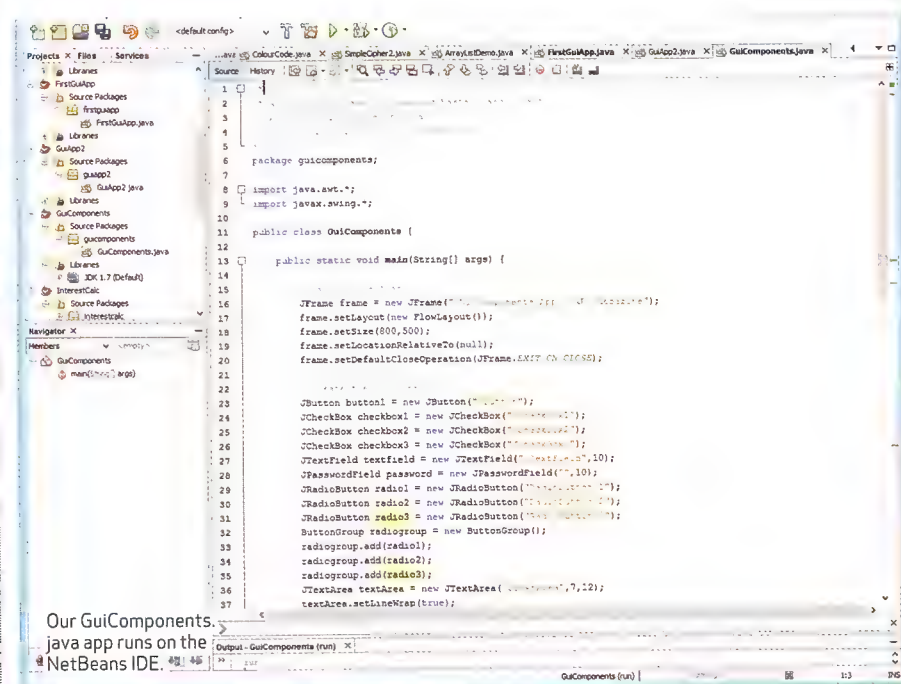
We'll talk about adding components to the JFrame in a second, but the important thing here is you don't add the ButtonGroup to the JFrame – it's not a GUI component, rather an abstract class. Instead, you add the JRadioButtons directly to your display panel. Just make them items of the same ButtonGroup to get mutually-exclusive operation.

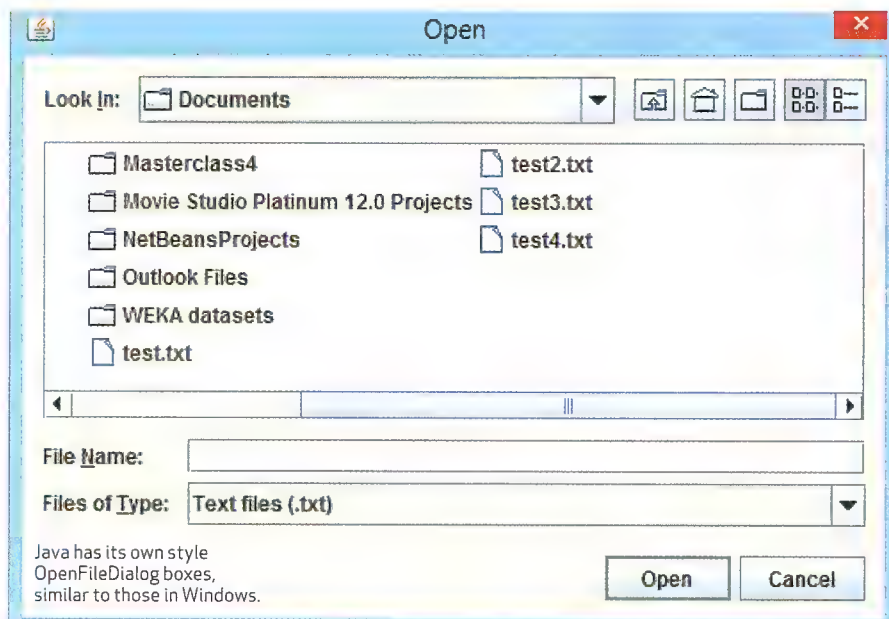
JTEXTAREA

Want to make your own text editor? JTextArea is the component for you. It provides a large-area text input panel, to which, you can add cool extras like line-wrap and word-wrap, even change the font and colour of the text. Java also has a JScrollPane component we haven't added here that provides the ability to scroll the text beyond the visible area, both horizontally and vertically. Even with no extra code, you can already copy/paste/delete/move text, so it's full of beans right from the get-go.

JLABEL

JLabels are really useful components – you can use them to provide simple text labels to things, but you can also use them to display images, like we've done here. The text 'APC Magazine' underneath the cover image is part of the JLabel and here, is added the same time as the image. There are extra methods (setVerticalTextPosition and setHorizontalTextPosition) that determine the text location relative to the image. If you're thinking about doing extra-cool stuff like image





manipulation (rotation, changing geometry and the like), JLabel isn't the way to do it – JPanel is much better for this. Still, JLabel is a convenient option for simple image display.

IMAGEICON

To display an image in a JLabel, JButton or other component that supports images or 'icons', you first load it into an instance of the ImageIcon class, which supports JPEG, GIF and PNG images straight off the bat. You'll notice in the code line the filename is 'resources\magcover.jpg'. The 'resources' folder is a subfolder of the GuiComponent project folder – you make that folder yourself, but it's a way of adding extra files or assets to your apps in an app-friendly way. Take a look at the GuiComponent app source code folder and see the magcover.jpg image inside that resources folder.

JSLIDER

To scale something or adjust audio volume for example, JSlider is your go-to component. You can set the major (longer) and minor (shorter) ticks along the slider control or just do without them. It's another commonly-used component and the perfect way to perform this type of task.

JLIST

Everyone loves lists and JList is a really versatile component with lots of tricks. It can handle multiple selections at once and you can set how much of the list (how many rows) are visible. However, to do that (and get the automatic scrollbars), you need to use the 'JOptionPane' component, Java's scrollable content box. You add the JList to the JOptionPane, and then add the JOptionPane to your display area. It's a little clunky, but only because

RadioButton 1

RadioButton 2

JRadioButtons allow you to make a single choice from a number of options.

you've got ultimate control over how the content is displayed.

The items in the JList come from a String array that you can add anonymously when you create the JList. It'll also automatically set the list width to the longest word.

JCOMBOBOX

Comboboxes are great GUI components, they let you create a tight little compact control of fixed options the user can select from. They're also known as drop-down boxes. The one thing I'm disappointed about Java's implementation is that it doesn't allow you to also type in your own option like a textfield. Other languages incorporate the drop-down menu with the textfield to make it a truly 'combo' box. Still, the JComboBox is incredibly useful and you'll likely use these in your apps by the bushel.

ADDING TO THE FRAME

So far, all we've done is create all of these GUI components. In order for them to be seen, we need to add them to our display panel, which in our case is straight onto the JFrame called 'frame'. You do this with the simple 'add' method. Given the way we've set up the JFrame, the order in which you add the

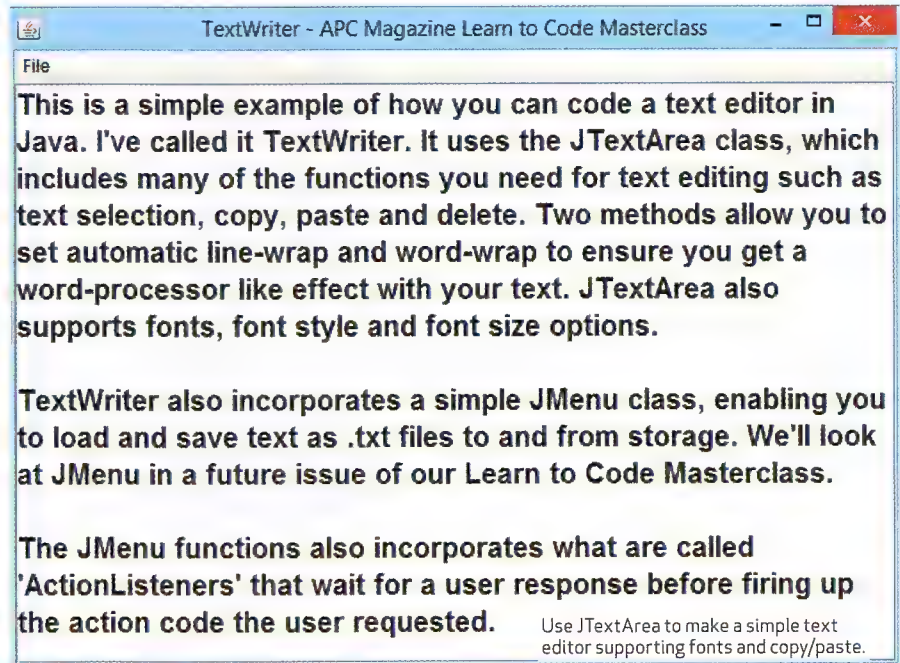


Now, true, the whole thing looks like a dog's breakfast at the moment, but Java has far more competent ways of arranging components, using its `LayoutManager` class. If you go back to the top of the main method, you'll see the codeline:

The Layout Manager provides three basic ways of laying out your components – flow, grid and border. We’re using ‘flow’ here and as it sounds, it simply flows on one GUI component after another. GridLayout, however, lets you break up your display window into a grid pattern, while BorderLayout divides the window into a series of compass-like regions.

Java's Layout Manager provides you far more control over the placement of components than we're using here (you can mix layout managers together, for example), to give your app a look and feel that's easy to use, especially if you resize the app window. This is a crucial feature, particularly when building Android apps for mobile devices with varying screen resolutions and sizes — having your apps correctly fill the display area is what a good layout manager does automatically for you. We'll look more in-depth at layout managers shortly.

In the meantime, have a play around with the source code for this project. See what happens if you comment out that 'setLayout' codeline. Try changing the order of the 'frame.add' codelines to



```
package firstguiapp;  
  
import javax.swing.JFrame;  
  
public class FirstGuiApp {  
  
    public static void main(String[] args) {  
        JFrame frame = new JFrame("First GUI app - A  
        frame.setSize(600,400);  
        frame.setLocationRelativeTo(null);  
        frame.setDefaultCloseOperation(JFrame.EXIT_O  
        frame.setVisible(true);  
    }  
}
```

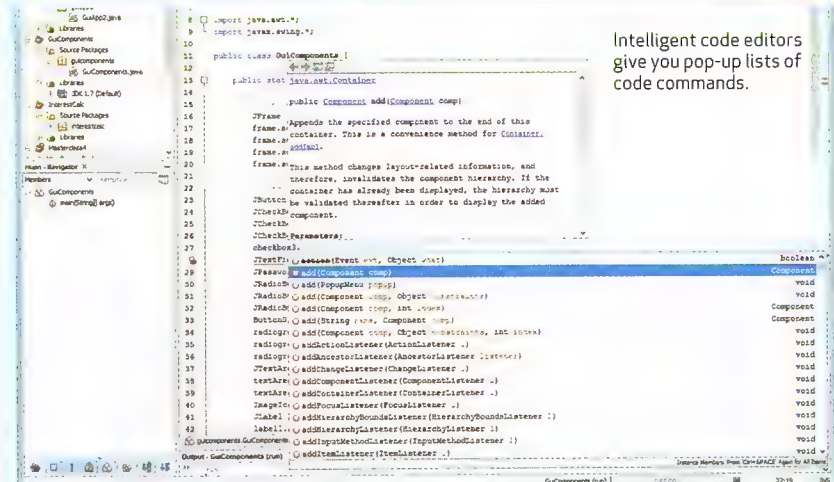
Putting a frame
up requires only a
half-dozen lines
of code.

see what effect it has. Hopefully, you can see there is a basic pattern to how Java creates and allows you to modify GUI components – you create them, modify them with ‘set’ methods and add them to your display area.

Next time, we'll look at 'Listeners' – classes that monitor GUI components to fire up our code functions. ■

Finding new commands.

The great thing about ‘intelligent code editors’ like NetBeans is that they provide you with a list of context-sensitive commands right at your fingertips. You’ll eventually come to remember plenty of Java commands simply by repetition (so keep coding!) but you don’t necessarily have to. Just type in an object variable and press the period ‘.’ button and the editor will create a pop-up window full of suitable command options. You can write your code in WordPad if you like, but a good code editor can make the task so much easier.





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Evolve

A crossbreed of co-op and competitive FPS.

Evolve is a jetpack dance between prey and predator, a multiplayer tango with ever-shifting positions. In a typical round, you go from being a frag god to fragile and back again in about 12 minutes. One moment you're a firebreathing Goliath, the next you're a fleeing, bloodied heap, scraping the map for alien wildlife to chew on.

Evolve's rhythm differs between map and mode, but it's generally the tightest FPS multiplayer since *Titanfall*. For the four Hunters it's all about pursuit, with little time to plot, joke or catch your

breath. That pace instils a feeling of constant urgency, but also makes it more fleeting than other multiplayer. The four-versus-one format is exactly the sort of asymmetry we need more of in the genre, but we've rarely ended up with war stories we're gagging to share, like we did with *Left 4 Dead*.

Unlike Evolve's zombie ancestor, though, it's a fleshed-out competitive game, and the most ambitiously uneven entry in the genre since *Rising Storm*. Its dozen Hunters – three for each of its four classes, with more on the way as paid DLC – form a spectrum of interesting playstyles. Bucket, one of the

Supports, unscrews his robot head and spits out guided missiles, while Lazarus is a medic who lets teammates die before healing them. The variety is vast.

SCI-FI SAFARI

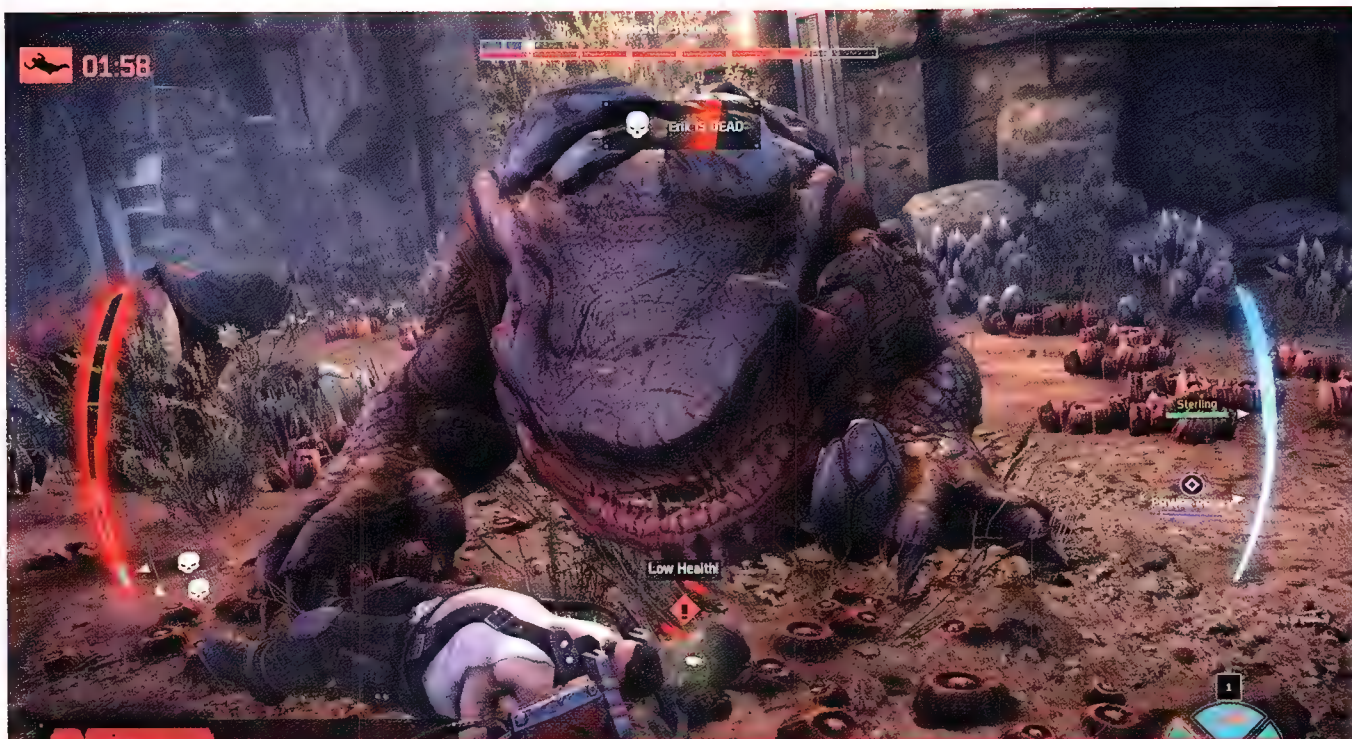
And along those lines, these weapons and abilities have their own specific skills. Developer Turtle Rock extends that "easy to learn, hard to master" virtue across most of the experience and Evolve benefits immensely. On both the monster and Hunter sides there's a focus on cooldown management that we like. The Hunters' jetpacks always feel starved – knowing when to conserve

juice as you're trying to keep up with a beast who's straight-up quicker creates an interesting tug-of-war.

The monsters have their share of tough-but-fun movement techniques to master too. Paranoia permeates everything and that fear drives you to do anything you can to shave seconds off of your traversal time. We had a blast learning micro-skills like killing wildlife in groups so that we could slurp up their corpses quickly. The trickier skill is stealth – successfully sneaking your way through a Hunt round makes you feel like a two storey-tall ninja.

The Wraith became our favourite of Evolve's aliens.





"The four-versus-one format is exactly the sort of asymmetry we need more of in the genre, but we've rarely ended up with war stories we're gagging to share, like we did with *Left 4 Dead*."

Her movement style (hovering and lunging) and fragility encourages hit-and-run tactics. We loved frustrating Hunters with the decoy ability, which spawns an AI-controlled mirror-Wraith — they find it brilliantly annoying.

The game is best in Evacuation, where a group plays five successive rounds on a mix of maps and modes. This format doesn't address the game's brevity, but it does form a bit of history between players and creates the opportunity for comebacks.

Other than Hunt, the three other modes within Evacuation do an OK job of stimulating different playing styles. Nest, where the Hunters have to destroy six monster eggs, is probably best. The Hunters must decide if, when, and how much to split up, a manoeuvre that makes them more vulnerable but means they'll succeed quicker.

Despite their simplicity, Nest, Rescue and Defend have some good tactical wrinkles, but there are also moments when they feel mundane. The objectives don't generate fun in isolation — they rely on the monster stirring up trouble.

Evolve also leans heavily on its matchmaking system. It takes coordinated Hunters to keep pace with an experienced monster, or a clever monster to challenge Hunters who know every trick. Most of our solo matches put us in satisfyingly tough games — nearly every time it felt like we were being exposed to new tactics.

We had a worse time with players of mixed skill levels. That isn't a fault of the matchmaking — Evolve's balance is such that a Hunter team is only as strong as its least agile member, something to take into account if you're playing with friends.

Luckily, this is less of an issue in Evacuation, which balances the match over time. If you continue to lose, you'll get stronger. The competitive purist won't be wild about the idea, but it does make one-sided shutouts unlikely. Also, you can disable it by creating a custom match.

Our feelings about Evolve's 16 maps are mixed. They're well-designed, spacious arenas, but they're also surprisingly homogeneous. The few map-specific features within them don't prompt different playstyles,

something that will erode Evolve's replay value.

MULTIPLAYER MAYHEM

A couple of other aspects of Evolve's multiplayer structure undermine its appeal. Evacuation's voting system is odd. Between each round, the four Hunters and monster cast votes on potential combos of map and mode. But it's an illusion of democracy as the Hunters always have a majority.

More frustrating is how easy it is for players to leave a match. The penalty is a 60-second timeout — more an invitation to nip to the toilet than meaningful discipline. Likewise, if one of your friends crashes, their spot in that match isn't reserved. On the upside, when the AI tags in, it's usually competent enough to not get you killed, but it lacks the creativity to take advantage of Evolve's weird weapons and abilities.

Given how much of your time is spent chasing, it's appropriate that a night of playing feels like a series of sprints. If you lose, a rematch is a 10-minute proposition, something that counterbalances Evolve's intensity. But after unlocking

everything we're less motivated to keep playing. We wish Turtle Rock would've doubled-down and built a bespoke ranking system like that of *League of Legends* or *StarCraft 2*.

Evolve certainly has the depth to support such a system. Its emphasis on skilful movement and out-maneuvring your opponent are unique. The Hunters and monsters have some of the most elegant, simple-but-deep mechanics we've laid hands on. And it's one of the best-looking games on PC, blessed with splashy particle effects, smart UI, and monsters worthy of *Pacific Rim*. But we're concerned about its longevity. It has tons of novelty, but without maps that bolster its replay value we worry about how well Evolve's paid DLC and planned free map releases will keep pace with players' fatigue.

■ Evan Lahti

Verdict

A refreshing asymmetrical FPS; great competitive depth; looks stunning; seriously intense.





FROM \$59.95 | PS4, XO, PC, PS3, 360 | DARKSOULSII.COM

Dark Souls II: Scholar of the First Sin

Or: re-learning to sin when you're winning.

It was about an hour in, once we reached Heide's Tower of Flame, when we realised that *Scholar of the First Sin* is exactly what we wanted it to be. Essentially a rejig of the *DSII* we know and love, this current-gen re-release does much more than simply serve up the PC version's visuals with the stellar DLC collection.

Alongside such admirable feats, *Scholar* also manages to force those who have passed through the corridors, caves and climes of Drangleic hundreds of times to rethink their approaches. It forces us, basically, to sheath our cocksure trail blazing and raise our shields in sweet trepidation once more.

Take the aforementioned Heide's Tower. Previously this area was home to hulking, bearded statue types, whose attacks would carve vast swathes of the air around them to get at you. We mastered these chaps through hours of failed attempts. We know when to pull them, when to roll, when to backpedal and when to get our hits in. Here in *Scholar*, these enemies are augmented by the Heide Knights themselves. These

white-clad warriors sit passively until they are attacked, at which point they'll harangue you with lightning-fast swipes and hard-to-read strikes.

You'll need to measure up whether you want to take on these guys or leave them sitting forlorn as you muscle through the rest of the area. And — naturally, knowing FromSoft's ways by now — there's an extra twist to this game of will-you-won't-you. Best the area boss and suddenly, laden with his tasty souls as you are, all of the Heide Knights you left behind will awaken and chase you across the map. A masterful touch that will have you both agape and legging it to the nearest bonfire.

FLASK CHANCE SALOON

Perhaps a little less surprising is that *Dark Souls II* on current-gen outstrips its last-gen counterpart at almost every turn. The most immediately appreciable factor is that frame rate. At 60fps it's silky smooth, so much so that we actually found ourselves having to slightly alter the speed at which we played. The character models and

environments are generally a lot crisper now, too, with minute details, such as the embossed covering of a Twin Dragon Greatshield or the leathery dimples on your wanderer coat really popping out.

The lighting feature removed at initial launch is back and you'll find yourself entering areas which are jet black without torchlight to guide you. Where once these flaming brands were used sparingly, now you'll find yourself praising the sun every time you pick up a Flame Butterfly, a newly essential item used to light a torch without trailing back to a scone or bonfire.

REMIX VERSION

It can be nail-ruining stuff, especially as many of the enemies you wouldn't normally meet until later in the game now get up in your grill much, much earlier. Heck, one enemy you come across in the Shaded Woods can't usually be spotted until you've restarted in New Game+ in the original version. Is it worth veterans unsheathing their greatswords once more? Yes. The returning lighting system and artfully re-

placed enemy encounters ensure you can tap into that sense of discovery, foreboding and mastery that was once so prevalent and has since become rote.

We kept thinking of *Fallout* and *Skyrim* when we're playing *Scholar*. You know how sometimes when you've played those games for a while you feel like starting over from scratch? You can drop all of your inventory off at a house, or even load a new game and just walk in another direction to see what's there. In *Dark Souls* it's your own experience that gives your character most of its power, rather than arbitrary numbers attached to gear found on the way.

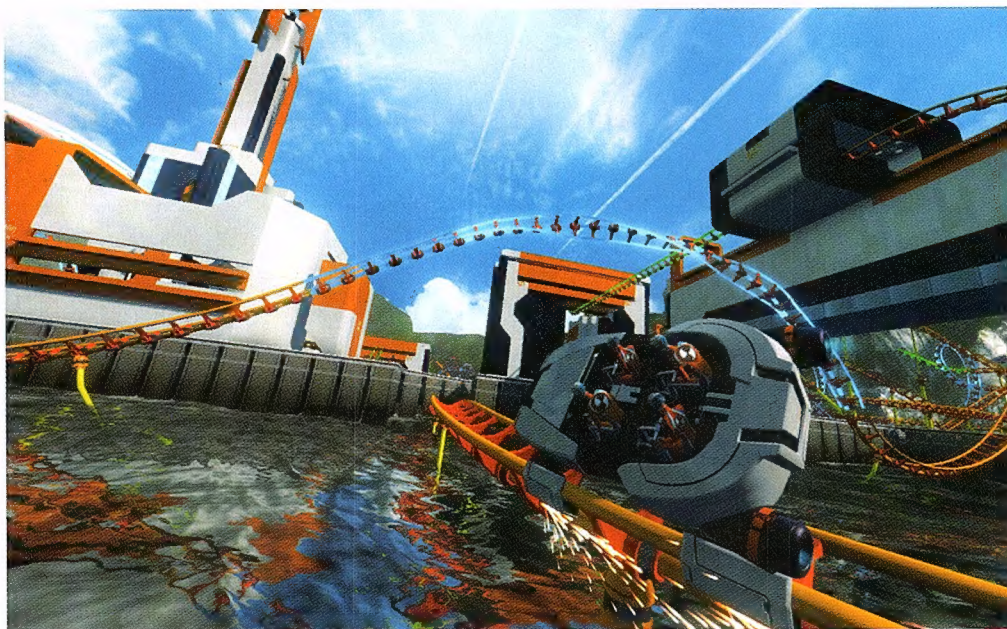
You can't lose all of that knowledge; you're stuck with it. By releasing this version, FromSoft has allowed players a chance to truly rediscover one of the most involving game worlds in existence. And that is quite something to behold.

■ Andy Kelly

Verdict

Last year's best game. Add another half a star if you've never played before...





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ScreamRide

A trip to the coast is full of ups and downs.

It's hard to pin this down into a single category. On one hand it's a rollercoaster construction simulator. On the other it's a steering-free racing game. And throw in a demolition mode that's like a cross between *Angry Birds* and PS3 sort-of-classic *Pain*, and we're still none the wiser. While all three segments work well on their own, the overall package is as disorientating as a high-speed triple corkscrew.

Although Frontier attempts to meld all three parts into one cohesive career mode, the seams are visible from space. What's intriguing from the off is *ScreamRider*. We initially scoffed at the idea of a rollercoaster racing game — just how exciting could a literal on-rails racer be? The answer is 'very', which caught us by surprise too. You grab bonuses for going on two-wheels, boosting off the track, and landing jumps perfectly.

There's more depth than meets the eye as a technical combo system allows you to chain together moves that achieve high scores. The game not only shares the

futuristic looks of *Trials Fusion*, it also has the 'one more go' feel to it that keeps us aiming for bigger and better scores.

Elsewhere, Demolition Expert steps off the rails and thrusts you behind the controls of a rotating arm that flings cabins of destruction. You have various shaped vessels to launch and the trick is to hit just the right trajectory to topple the buildings in the distance. As we mentioned earlier, it's like a 3D *Angry Birds* and the physics allow for some chaotic domino effects. Add in some well placed explosives and you've got a really satisfying wrecking ball mode.

Finally, there's Engineer, which harks back to Frontier's *Rollercoaster Tycoon* games. Complete broken tracks or build your own vomit-inducing thrill ride with extreme twists, loops and drops in a simple drag-'n'-drop fashion.

It's a little odd that Engineer somewhat takes a backseat in proceedings, as it's arguably the game's strongest suit. We doubt it was intentional to hide it, but it's typical of the poor

overall delivery.

Those seams we touched on earlier revolve around the career mode. You unlock new levels by achieving Commendations, but the method by which you do this is a mess. Arbitrary missions such as 'complete a run without derailing' or 'get three million points in Demolition Expert' have an unclear effect on progression.

It's also packed with needless filler. There's a loose story about thrills being outlawed and those that seek them must become fleshy crash test dummies.

ScreamRide is fun, but suffers from its poor signposting, last-gen visuals, and padding. There's fun to be had with this three-pronged thrill ride, but it's hidden behind an impenetrable exterior and a scattergun approach to career mode.

■ Nathan Irvine

Verdict

The game modes may keep you hooked, but the good stuff is obscured through a poor UI.



Blackguards 2

The girl's got Cass.

US\$34.99 | PC
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Sometimes it feels good to be bad, and the cast of this turn-based strategy RPG is about as crooked as they come. You play Cassia Corapia, an exiled queen recently free after four years trapped in a spider-filled labyrinth and out for revenge on the scheming husband who put her there. Gathering an army of convicts, cultists and cut-throats, she vows to steal his kingdom out from under him, no matter the dark deeds she'll have to do along the way. It's the characters and story that really make *Blackguards* shine, brought to life by some seriously impressive voice acting. Despite their rather dodgy moral outlooks, Cassia's companions are endearing and darkly hilarious, and the queen herself, driven insane by one too many poisonous spider bites, is one of the most interesting and different fantasy leads out there. The actual gameplay, consisting mostly of combat strung together by an overland map, is unfortunately rather less exciting. The scenarios and locations are well-designed and diverse, but the nuts and bolts of the fighting are simplistic and clunky. Character progression is impressively open and detailed, but the confusing over-abundance of options makes spending your points feel more like filling out your tax return. That said, there's enough here outside of the combat — mostly that eclectic cast and their interactions — to balance it out.

■ Robin Valentine



"Viewers can message the eaters, who then verbally respond on camera."



I like to watch

Live food porn, or a new form of social eating?

A strange trend has swept South Korea of late — it's called Meok-Bang, and it involves people eating large amounts of food on webcam while thousands of other people watch.

The phenomenon began on the Korean webcasting channel Afreeca TV, and while viewers can watch for free, many choose to award the 'performers' by giving them 'star balloons' which translate into real money in their bank accounts. Some eaters earn hundreds of dollars a night.

Sounds weird, though it's more social than it sounds — viewers can message the eaters, who then verbally respond on camera. Perhaps they just don't want to eat alone?

PonoPlayer no better than iPhone?

Many critics seem to agree.

Neil Young's much-hyped PonoPlayer, the expensive Kickstarter-funded digital music player that promised soul-shattering audio of the highest quality possible, has been met with complete and utter disregard by critics and audiophiles, stating that the awkward Toblerone-shaped player's premium-priced music sounds pretty much indistinguishable from the compressed music purchased on iTunes. Writers from several publications enlisted people to test the PonoPlayer against an iPhone — the overwhelming majority of test subjects either admitted to not hearing any discernible difference, or even preferring the iPhone version. The PonoPlayer costs US\$399 and has raised US\$6.2 million from its Kickstarter campaign since last year.

Robot vacuum attacks

This is why we need Asimov's Three Laws of Robotics.

In a harrowing scenario fit for a dystopian science fiction novel, a robotic vacuum cleaner in South Korea reportedly attacked its owner's hair as she innocently slept on her apartment floor. The 52-year old Changwon resident awoke in pain to find her hair sucked into the vacuum, unable to free herself from the nozzle's vice-like grasp. The woman immediately called the fire department for help, presumably because futuristic soldier Kyle Reese will not reach full robot-killing maturity until the year 2021. Paramedics eventually freed the woman, at the cost of several strands of hair. So far, there's no word on whether the vacuum was manufactured by Cyberdyne Systems. ■



COMPANY EXECS GET DIRTY OVER WASHING MACHINES

LG EXECS ACCUSED OF BREAKING SAMSUNG WASHING MACHINES, SAY IT'S NOT THEIR FAULT THEY WERE "SHODDY"

State-of-the-art washing machines may have ironically caused LG Electronics to play dirty against rival company Samsung, with LG executives accused of deliberately damaging several high-end Samsung Crystal Blue washing machines at a Berlin trade show. The execs have been indicted, and various suits and countersuits have followed since.

LG claims there's insufficient evidence, even releasing its own surveillance video of the execs inspecting the machines in front of uniformed Samsung staff.

In true mudslinging fashion, an LG spokesperson also told the *Wall Street Journal* that "unlike washing machines from other companies, a certain company's washing machine model was particularly weak on the hinges."

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- 16 x VPN tunnels with hardware accelerator & VPN Fail-Over
- Advanced Wi-Fi for Vigor2912n

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